Ability + Motivation: Understanding Factors that Influence People with Cognitive Disabilities in Regularly Practicing Daily Activities

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ABSTRACT

People with cognitive disabilities may experience challenges in consistently performing daily activities because they skip steps, struggle to track progress, or lack the motivation to complete them. These challenges are often along a range; people need assistive devices customized to their specific needs. However, existing assistive technologies, like prompting systems, lack the capabilities to customize support for diverse needs. With the advent of smart home devices, there are opportunities to design prompting systems that support diverse accessibility and motivational needs, thereby supporting the regular practice of daily activities. To understand design factors for such devices, we interviewed adults with cognitive disabilities, parents, and caregivers. Our participants described their needs for future prompting systems, including structuring tasks, supporting motivation, and introducing community support. This paper presents insights and design suggestions for context-aware assistive technologies that could help people with cognitive disabilities regularly perform everyday activities.

CCS CONCEPTS

• **Human-centered computing** → Accessibility; Accessibility design and evaluation methods.

KEYWORDS

regular practice, personalized scaffolds, prompting strategies

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1 INTRODUCTION

People with cognitive disabilities often face obstacles, like challenges with remembering, planning, making decisions, and paying attention [3, 4]. These challenges can vary; individuals with similar diagnoses can have different abilities and thus face several barriers in their daily lives. Because of their diverse abilities, people need a range of support specific to their needs. Historically, individuals have used assistive devices, such as prompts, timers, and to-do lists, and obtained physical assistance from caregivers to support their everyday activities.

Daily activities are often integral to living independently — many people with cognitive disabilities hope to achieve autonomy with minimal support in their everyday activities. Daily activities are usually classified into two categories — 1) activities of daily living (ADL), including personal tasks, like dressing, eating, or bathing, and 2) Instrumental Activities of Daily Living (IADL), including social tasks, like traveling, communication, or shopping [35]. ADLs are essential to independent living between the two categories because they are required to maintain good health and hygiene. Independent living can be interpreted in many ways within this user population. It has the same meaning, but people may have different goals and expectations. Most individuals consider performing daily activities with minimal support as living independently, while others might consider obtaining a job with caregiver support as more independence. This research focuses on individuals who can become independent by delegating specific caregiver support tasks to an assistive device customizable to their needs.

Ability and motivation can play an equally important role in the regular practice of daily activities. People with cognitive disabilities face various accessibility and motivation barriers daily [3]. For example, some individuals might skip steps or lose track of their progress during an activity. Others might need more motivation to initiate, continue, or complete activities. These barriers can create negative consequences, like increased health risks or dependence on caregivers, which can further impede the goal of independence.

Prior work has primarily focused on supporting accessibility barriers by creating prompting systems that provide stepwise guidance and reminders for everyday activities [3, 24, 46, 55]. However, existing prompting systems address specific obstacles and cannot customize support for various abilities. Furthermore, individuals must often pause their activity and view prompts on a separate device, like a phone or tablet. For example, individuals often pause brushing their teeth to see specific instructions. Repeatedly switching contexts can lead to negative consequences, like increased distraction, abandoned tasks, or additional dependence on caregivers or parents [56, 59]. Lastly, most prompting systems only provide instructions and do not integrate continuous on-task feedback or personalized motivation to help individuals persist with activities. These feature deficits can even result in irregular routines preventing individuals from being independent [34, 56, 59].

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With more smart devices being adopted in homes and workplaces, there are opportunities to design assistive devices customizable to people with a wide range of abilities. Smart devices, like voice assistants and smart appliances, can customize activity prompts with limited supervision and reduce context switching by naturally integrating prompts in place [22, 23], thereby reducing the number of distractions and cognitive load needed during activities [45]. Devices can also incorporate multiple motivational strategies to help individuals initiate activities, maintain attention, and persist with activities.

Designing such devices raises numerous questions, like how regularly individuals perform their daily activities. What activities are most or least motivating? What types of accessibility barriers affect regular practice? How can future prompting systems adopt existing community-based support strategies? Gaining a deeper understanding of these questions can help design future smart devices that can customize support for various accessibility and motivational barriers for people with cognitive disabilities. We conducted an online participatory design-based interview with adults with cognitive disabilities, parents, and caregivers. We asked participants to categorize their daily activities using digital sorting tasks based on three factors essential to regular practice: frequency, motivation, and ability. First, we wanted to understand how frequently individuals practice daily activities. Secondly, we wanted to learn how motivated individuals were to practice activities. Finally, we tried to understand participant reflections on how easily individuals performed the activities.

By engaging participants in the design interview, this paper answers the following research questions:

- Which daily activities are essential for people with cognitive disabilities to achieve independent living goals?
- What factors prevent people with cognitive disabilities from regularly practicing their daily activities?
- What factors influence and motivate people with cognitive disabilities to maintain their daily activities consistently?
- How does the relationship between motivation and ability affect people with cognitive disabilities to practice daily activities regularly?

2 RELATED WORK

Our research is guided by three primary research areas: how people usually develop regular behaviors, the benefits and drawbacks of existing assistive devices, and effective methodologies to engage people with cognitive disabilities in design-based research.

2.1 Developing Regular Behaviors

Popular goal-setting theories and behavioral models suggest that developing regular habits requires sufficient motivation and ability [20, 36, 48]. Creating routines of daily activities and following them regularly is essential for people with cognitive disabilities to live independently. Existing theories explain that behaviors are more likely to become routines if they are easy and exciting. Behaviors that are boring and difficult are less likely to turn into routines. Behaviors often become difficult due to the lack of time or money, the amount of physical or mental effort, or the inability to structure them into current routines [20].

Prior research has suggested several strategies for regularly performing behaviors. One helpful strategy is repetition [20, 36]. Practicing a behavior multiple times can make it easier. *Anchors* can be another strategy to encourage regular practice, where new activities are linked to familiar ones. The goal is to use one activity as a reminder, or an *anchor*, for a new one [20, 28]. *Implementation Intentions* is another strategy to achieve goals and form regular behaviors [26, 40]. This concept promotes a concrete and procedural strategy, where you frame behaviors with a specific situation: "If situation Y is encountered, then I will initiate goal-directed behavior X." Positive reinforcement, like applauding success, can also reinforce behaviors [13, 14, 20]. It is important to celebrate immediately after practicing new behaviors to create routines. Existing in situ prompting systems incorporating gamification elements align with the positive reinforcement strategy [29]. Therefore, motivation and ability are equally crucial for regularly practicing everyday activities.

2.2 Prompting Strategies to Support Accessibility Barriers in Daily Activities

Prompting is a common strategy to support individuals by presenting a list of steps through text, images, and verbal instructions [7]. This paper focuses on two broad prompting areas: traditional systems, like handheld prompters, and in situ systems, like smart assistants.

2.2.1 Traditional Prompting Systems. Most community homes use conventional approaches, like picture cards or computer-based prompters, to support individuals in their everyday routines. Picture cards are a common strategy to prompt individuals with cognitive disabilities during chained tasks, like food preparation [6, 33]. However, picture cards can get shuffled or misplaced.

Computer-based prompters became a popular solution to overcome the challenges of picture cards. Systems presented verbal and image-based instructions [7, 10, 53] on personal computers [37, 47, 58] or handheld devices [10, 53, 57]. Some devices presented prompts with a time delay to limit the cognitive load involved in system interactions [19, 49]. However, individuals with cognitive disabilities have a range of abilities; and, thus, require guided, contextual support during activities, like tracking progress with continuous feedback or receiving motivation to complete activities. Most traditional prompting systems lack in situ support. To overcome these drawbacks, individuals often seek assistance from caregivers, which can lead to negative consequences, like being less independent because of increased reliance on staff.

2.2.2 In situ Prompting Systems. Researchers have explored context-aware assistive devices to overcome the challenges of traditional prompting systems. COACH is a computer-vision-based prompting system that detects user actions and shows video-based prompts for washing hands [38]. Similarly, TEBRA uses contextual awareness to prompt users with visual instructions while brushing their teeth. This system learns spatial and temporal variances of users before prompting them [41]. Kinect-based prompting systems have helped train individuals in vocational jobs, like meal preparation, by using depth cameras to detect gestures and display

multimodal prompts [9]. Voice assistants can help people with cognitive disabilities by scheduling tasks, providing stepwise guidance, and recommending activities [42, 43, 50].

Recently, augmented reality (AR) has emerged as a helpful technique to overlay visual prompts in place and assist individuals in completing assembly-based tasks [22, 23, 31]. This can help reduce the number of context switches in activities. Combining AR with other modalities, like audio and tactile methods, and gamification features can help motivate individuals to complete tasks [29, 30].

2.3 Engaging People with Cognitive Disabilities in Design Research

Prior research has employed participatory and codesign techniques to engage people with cognitive disabilities in the design cycle. Participatory design methods have helped design a planner using sound and images for people with aphasia [39]. Individuals participated in an iterative user-centered design process where they brainstormed ideas, created low-fidelity prototypes for a planner, and evaluated a high-fidelity prototype. Like individual sessions, group design workshops can help engage individuals with cognitive disabilities [2].

Traditional design methods can create accessibility barriers for people with cognitive disabilities [12, 16, 17, 21, 27, 44, 52, 54]. Researchers have explored approaches to adapt design methods for this population. Design activities that use low-fidelity prototypes and walk-throughs can be more effective than mid or high-fidelity prototyping and think-aloud procedures [11]. Simple prototypes that support nonverbal interactions or Augmentative and Alternative Communication (AAC) devices can help individuals express ideas [25]. Specifically, employing multimodal methods can aid the design process. Researchers initially engaged individuals in focus groups to understand communication barriers during consultations. This was followed by individuals creating an image board by critiquing and choosing images that best represented their symptoms. Then, they placed mockups of UI elements on a paper representation of a tablet to indicate their preferences. Finally, participants evaluated a digital prototype to provide feedback on communication requirements during consultations.

Caregivers and parents are essential contributors to design research within this community. They have experience and expertise in training and supporting individuals in everyday activities [5, 17, 51, 52]. Furthermore, they can complement the perspectives of people with cognitive disabilities by explicitly describing prompting strategies or explaining how strategies have evolved with individuals' abilities. MAPS is an example of a prompting system codesigned with caregivers and individuals with cognitive disabilities [8]. Similarly, Dawe engaged individuals and their families to design a mobile phone-based prompting system [18]. While staff and family members contribute significantly to the design process, prior research recommends caution against neglecting the needs and goals of individuals with disabilities [16].

2.4 Research Contributions to Existing Literature

Smart devices show great potential for customizing prompts and supporting people with cognitive disabilities in everyday activities. This study focuses on adding knowledge for future devices by gaining a deeper understanding of the types of barriers individuals with cognitive disabilities face to maintaining regular practice. This paper also presents prompting strategies currently used by individuals and caregivers and discusses how future smart devices can adopt these strategies to scaffold prompts for various abilities.

This study also enhances existing literature by presenting a remote participatory design interview to understand how adults with cognitive disabilities, caregivers, and parents analyze their practice of everyday activities. We take a qualitative approach to learning activity patterns and how individuals interpret their daily activities based on frequency, level of motivation, and ability to do tasks independently. We present snapshots of participant activities: 1) to describe factors preventing regular practice; 2) to learn motivational factors promoting consistency; and 3) to understand barriers increasing difficulty. We also discuss how our findings correspond to existing theories on developing consistent behaviors.

3 METHOD

We conducted a 90-minute remote participatory design-based interview with 13 participants to understand design factors that influence and prevent the regular practice of daily activities. We wanted to learn how frequently individuals practiced activities, their level of motivation during the activities, barriers to independent practice, and effective strategies to overcome those barriers.

Our participants included adults with cognitive disabilities (A), caregivers (C), and parents (P) between the ages of 25 and 58. We primarily recruited participants from organizations that support adults with cognitive disabilities in community homes. We used snowball sampling to boost our recruitment efforts. All participants lived in community homes with staff support or with a parent and received services due to intellectual and developmental disabilities, learning disabilities, Autism, or ADHD. All participants could communicate their ideas verbally or through communication devices and indicated that they could interact with a computer via Zoom. However, we did not collect individual diagnoses from participants, instead focusing our work on functional abilities and challenges. We want to learn which activities are essential to living independently, factors that prevent regular practice or promote consistency, and understand the relationship between motivation and ability and how it affects regular practice.

All participants were above 18 years of age and completed a consent process before the study. If participants were not their legal guardians, we obtained permission from their parents or guardian. Most individuals with cognitive disabilities participated with their caregivers, except A1. One of the caregivers, C3, participated in multiple paired interviews because all the individuals with cognitive disabilities belonged to the same organization. Three caregivers, C1, C2, and C5, and both parents, P1, and P2, participated alone. We compensated all participants for their time and effort in the study. Table 1 describes demographic information about our participants and the makeup of the interviewed groups.

3.1 Study Procedure

We conducted the interview sessions on Zoom. All pairs were collocated and joined the meeting together. The sessions included

Table 1: Our participants included individuals with cognitive disabilities (A), caregivers (C), and parents (P).

Pairs	Participant	Age	Gender	Role	Communication Abilities
	A1	31	Male	Person with cognitive disabilities	Verbal
	C1	26	Female	Caregiver	
	C2	53	Female	Caregiver	
	P1	48	Female	Parent	
A	A2	51	Male	Person with cognitive disabilities	Verbal
	C3	34	Male	Caregiver	
	P2	40	Female	Parent	
B	A3	35	Male	Person with cognitive disabilities	Verbal
	C4	25	Female	Caregiver	
	C5	38	Male	Caregiver	
C	A4	46	Female	Person with cognitive disabilities	Verbal
	C3	34	Male	Caregiver	
D	A5	58	Male	Person with cognitive disabilities	Augmentative Alternative Communication (AAC)
	C3	34	Male	Caregiver	
E	A6	44	Male	Person with cognitive disabilities	Verbal
	C3	34	Male	Caregiver	

a design activity on Mural[1], a popular online design and prototyping tool. We chose Mural because of its easy setup and simple interactions to create post-it notes and enable collaboration on any browser. Using Mural, participants can create a list of their everyday activities and sort them into categories based on the frequency of performing activities, motivation level, and difficulty level in the activities.

3.1.1 Introduction: We began the study with an introduction to Mural. We provided a hands-on explanation for navigating Mural and creating post-it notes. Participants spent 2 minutes creating sample post-it notes by double-clicking on the canvas and dragging them around the screen.

3.1.2 Design Activity: Following the introduction, participants completed three design tasks that involved categorizing their daily activities based on how frequently they do the activities, their level of motivation, and their perceived level of difficulty in the activities. For caregivers and parents who participated alone, we asked them to think about their clients or their children during the design activity. Participants had access to Mural canvases with editing privileges. Additionally, the research team presented canvases on Zoom using the screen-share feature.

To support people of all abilities to participate and contribute to this activity, we provided two design options: 1) participants created post-it notes and sorted them into categories. This option translated to paired designing for individuals who participated with their caregivers, where individuals verbally described activities, and their caregivers created post-it notes. We still considered this self-design because caregivers and individuals are unique participants in the study; and 2) if participants preferred not to use Mural or found it challenging to navigate, they could describe activities, and the researchers acted as a proxy to create and organize post-it notes.

3.1.3 Task 1: Frequency of Practicing Activities. The first task focused on how frequently individuals with cognitive disabilities practiced daily activities. We began this task by sharing a link to the first Mural canvas (Figure 1). We also showed the canvas on a shared screen for conversational context. We asked participants about their weekly routine, including how weekdays differed from weekends. We asked participants to choose their busiest day and create post-it notes. These notes mentioned the names of all their daily activities during that day. Participants made additional post-it notes for the remaining days of a typical week. The canvas for this task had four categories, each associated with a specific color:

1. It's my routine (purple): do it almost every day
2. Do it often (yellow): do it quite frequently
3. Do it sometimes (green): do it occasionally
4. Never do it (orange): skip it or do it rarely

Participants categorized the post-it notes into appropriate boxes. They described their reasoning for sorting each post-it note into a specific category. They further explained barriers preventing them from doing activities more frequently and discussed strategies to maintain regular practice.

3.1.4 Task 2: Motivation Level to Practice Activities. Following task 1, we shared a second canvas on motivation, like Task 1 (Figure 2). We copy-pasted participant post-it notes from task 1. Participants

[1]https://www.mural.co/

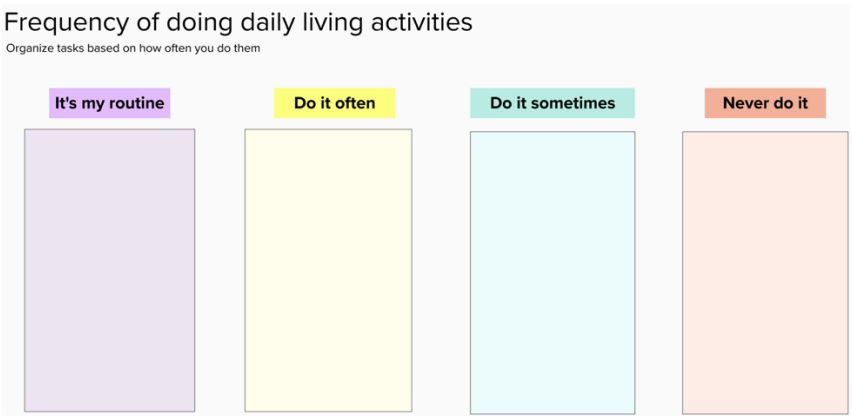

Figure 1: Canvas template for sorting activities based on frequency on a canvas with four categories denoting the four options, it's my routine (purple), do it often (yellow), do it sometimes (green), and never do it (orange).

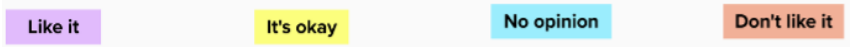

Figure 2: The four options for sorting activities based on motivation: like it (purple), it's okay (yellow), no opinion (green), and don't like it (orange).

Figure 3: The four options for sorting activities are based on difficulty: easy (purple), somewhat easy (yellow), somewhat difficult (green), and difficult (orange).

reorganized their previous post-it notes into relevant boxes based on their motivation to perform each activity. The canvas for this task had four boxes, each associated with a color:

1. Like it (purple): like it
2. It's okay (yellow): don't like it that much
3. No opinion (green): have no opinion
4. Don't like it (orange): do not like it

Like the first task, participants explained their rationale for categorizing post-it notes. They talked about their motivation to practice well-liked activities, barriers preventing the regular practice of less-liked activities, and strategies to overcome those barriers.

3.1.5 Task 3: Difficulty in Practicing Activities. The process was repeated for task 3, where participants were asked to organize post-it notes based on the difficulty level in each activity (Figure 3). The canvas for this activity had four boxes, each associated with a color:

1. Easy (purple): there is nothing difficult about it
2. Somewhat easy (yellow): some parts are difficult
3. Somewhat difficult (green): it is significantly difficult
4. Difficult (orange): there is nothing easy about it

Like tasks 1 and 2, participants described factors that made activities difficult, explicitly focusing on barriers preventing independent practice and their strategies to overcome those barriers.

3.2 Data Collection and Analysis

Data collected in this study included audio-video recordings, screenshots, and researcher field notes. We analyzed the data using open-coding techniques [15]. We triangulated the analysis across transcripts, notes, recordings, and screenshots. We initially used a line-by-line inductive coding process to create codes from transcripts and notes and validated these codes from recordings. We also analyzed screenshots to identify additional codes based on note content. We ranked tasks based on how they were sorted and validated them with observation notes and video recordings. We iteratively categorized the codes into broad themes, such as motivational barriers, ability-based barriers, and strategies to maintain existing tasks and learn new ones.

4 FINDINGS

We found that both ability and motivation are significant barriers to the regular practice of daily activities. This section outlines examples of ability-based barriers, like difficulties in tracking progress, struggles with remembering steps, difficulties understanding functionalities of accessories, and troubles monitoring multiple steps. Individuals were less motivated to perform essential daily activities tied to independent living, like brushing their teeth, doing laundry, cooking, or cleaning the house.

Figure 4: C1's client's activity pattern shows that essential activities become routines, even if difficult.

4.1 Accessibility Barriers Affecting the Frequency and the Level of Difficulty in Daily Activities

We learned that participants experienced several barriers in regularly practicing daily activities, like tracking progress, remembering how accessories work, or monitoring multiple tasks. For example, C1 described a client (who did not participate in the study) who loves all fashion-related activities, like dressing, styling, shopping, and laundry. However, she faces challenges in tracking progress and making decisions. Figure 4 illustrates C1's client's activity patterns on how ability affects the frequency of routines. C1's client does not entirely organize her clean laundry and usually abandons the activity midway. C1 describes that her client also finds it challenging to make decisions, like differentiating clean clothes from dirty ones, and sometimes dresses in her favorite clothes that may be dirty:

> "She will pull out a favorite skirt that might have food from the previous day. She'll sleep with her clothes on if she likes something."

Similarly, P2 described how her son has difficulty following the standard timer display format of "minute: second." For example, if the food must be heated for 2 minutes, he will press two instead of "2:00" (two and zero zero) on the keypad and try to start heating the food. Some individuals struggled with proportions, deciding the correct quantities for mixing drinks and monitoring multiple items. Instead of refilling the gallon-size pitcher, C5's client often pours the entire mix into a glass of water.

4.2 Motivational Barriers Reducing the Frequency and the Level of Persistence in Daily Activities

Most participants lacked the motivation to do house chores or to maintain good hygiene practices. Participants needed help paying attention and tracking progress.

Participants needed more motivation to clean their houses or organize their laundry regularly. For example, A2 usually leaves his clothes in the laundry basket after drying because he does not like organizing clothes and struggles with matching things, like socks. Similarly, A2 dislikes taking out the trash and cleaning his house (Figure 5). He finds it time-consuming to keep doing it regularly. Specifically, he dislikes taking out the trash multiple times during the week and changing trash bags. We learned that participants were also less motivated to cook because it needed planning, preparation, waiting, and continuous monitoring. A2 loves cooking fajitas, so the motivation is high. Still, he finds it somewhat difficult because of the time required to prepare ingredients and monitor the meat to ensure it is cooked to the right consistency.

4.3 Strategies Influencing and Motivating Consistent Practice

We wanted to understand the strategies people with cognitive disabilities and their caregivers use to overcome barriers. Community strategies are often personalized and can help us learn approaches to scaffold prompts and support individuals with various abilities and needs.

4.3.1 Positive Reinforcement to Regular Practice. We learned that positive reinforcement, like social interactions and appreciation, can help overcome accessibility barriers, like persisting with activities. Participants looked forward to activities involving interactions with friends and family members. Receiving appreciation from staff or a parent can be a huge motivator for participants to feel confident. For example, C1's client constantly looks for compliments about her outfits. This motivates her to dress independently.

Another positive reinforcement strategy that caregivers and parents use is *anchoring* well-liked activities with disliked ones to encourage individuals to initiate less-liked activities. This is often referred to as the "first-then" strategy within the community because caregivers and parents phrase it as 'first, let's do [disliked activity], then we can do [liked activity].' For example, C2 described a client (who did not participate in the study) who dislikes her doctor appointments, so she often anchors buying coffee (her client's favorite outing) with it. Similarly, P1 uses the first-then strategy to prompt her son when he plays with his friend. This activity can be

Figure 5: A2's activity pattern shows that high-motivation activities are frequent, and some low-motivation activities are infrequent. However, several disliked activities became part of the daily routine because of the larger goal of achieving autonomy.

tricky because instead of playing with each other, the two children play in parallel but on their own. To encourage her son to socialize with his peer, P1 often orchestrates playing as a turn-based game, where she will prompt her son to go on the slide, then encourage him to wait and watch his friend go on the slide. After each turn, the two kids will high-five each other to make it more fun.

4.3.2 Scaffolded Prompting Along with Visual Aids to Support Accessibility Barriers. We learned that caregivers and parents scaffold their prompting based on how well individuals practice daily tasks. They often start with reminders, followed by verbal prompts, switching to demonstrations, and finally physically assisting individuals. This can help individuals who struggle to remember steps or pay attention.

The first step in supporting individuals is to remind them to begin tasks. We found that caregivers often remind individuals to do house chores or maintain oral hygiene. If reminders alone don't work, caregivers use verbal prompts to help individuals correctly perform tasks. For example, most participants needed verbal prompts and physical assistance to brush their teeth thoroughly for 2 minutes. Caregivers often physically assist individuals when they either partially finish activities or do not practice them correctly. For example, C1 physically helps her client brush all sides of her teeth.

Besides practicing familiar tasks correctly, prompts and reminders can prevent individuals from developing "bad" behaviors. Reminders can also be part of "redirecting" strategies, often used to divert individuals from certain behaviors. For example, C1 verbally prompts her client to use the right amount of shampoo so she doesn't learn wasteful behaviors. C2 reminds her client, who struggles with budgeting, to wait for payday, the first day of each month, before buying things. Although C2's client doesn't work, the concept of payday has become familiar and effective in preventing impulsive shopping.

4.3.3 Structuring Prompts and Aids to Teach New Tasks. We learned that structured prompting is a common teaching technique for new tasks. Unlike the prompting process for routine activities, caregivers and parents begin with physical guidance, demonstrating each step and asking individuals to follow along. Once individuals master all the steps of the task, this support further reduces to reminders. For example, C1 taught her client to wash her hair by demonstrating how to pour the shampoo and scrub her hair. Over time, this changed to verbal prompts, and now her client washes her hair independently.

C5 uses scaffolded prompts to teach his client how to make a soft drink, which requires pouring one packet of the drink mix into a gallon of water. Instead of refilling the pitcher, his client pours the entire mixture into a glass of water. C5 often explains to his client that using the whole packet of the drink mix makes the drink concentrated and tastes weird. He then demonstrates how to refill the pitcher slowly by pouring the mix and adding water.

We learned that in situ instructions could be helpful when teaching new tasks. P2 uses a visual aid to train her son about entering heating time into a microwave. She described how her son has difficulty following the standard "minute: second" convention. To help him learn, P2 has attached a card above the keypad with "2:00" since that's the most common use of their microwave.

4.4 Motivation and Ability have a Complex Relationship

We found that motivation and ability have an intricate relationship with each other. We learned that individuals define ability as the capability of practicing activities within existing support structures. This means that ability and its relationship with difficulty can have different meanings. For individuals who can practice without caregivers, ability is defined as the capability to do activities independently. Whereas for individuals who work with caregivers daily, ability is the capability to practice activities with their caregivers.

Figure 6: C2's client's activity pattern shows that most well-liked activities become routines and are practiced regularly. However, some disliked activities become routines because they're essential.

This section uses behavioral models and goal-setting theories to analyze participant activity patterns further. We dive deeper into specific examples and explain how they diverge from existing approaches in maintaining a regular practice.

We found several insights into how activities are maintained and what activities become part of daily routines. Contrary to existing goal-setting theories and behavioral models, sufficient difficulty and motivation alone do not help develop a regular practice. Several factors can impact how individuals maintain their daily routine, like a diverse range of abilities or the need for assistive devices and support staff. We found that activities with low inherent motivation often become routines because independently practicing these activities is an essential milestone to achieving autonomy. Similarly, we found that activities with high intrinsic motivation may not become routines because of accessibility barriers and the lack of support structures.

4.4.1 Low Motivation Activities often become Routines. We learned that individuals need more motivation to practice essential daily activities, like brushing their teeth or cleaning. However, diverging from existing behavioral models, these less-liked activities often become routine because they are tied to independent living. For example, C2's client does not like cleaning her mouth and finds it difficult, but it is part of her daily morning routine (Figure 6). P1's son dislikes brushing his teeth because he struggles with the sensation of the toothbrush against his mouth. However, P1's son brushes his teeth because it's essential to maintain personal hygiene and one of the primary goals for independent living (Figure 7). Likewise, A2 dislikes many physically exhausting house chores but schedules them into his routine to maintain good hygiene. However, certain disliked activities did not become part of daily routines. For example, C2's client does not like cleaning; thus, it never became part of her client's routine. C2 has removed cleaning as one of her client's objectives for achieving autonomy.

4.4.2 High Motivation Activities may not become Routines. Despite the inherent motivation, well-liked activities may not become routines. For example, A6 enjoys cooking and cleaning dishes but rarely does it because his roommate exhibits unsocial behaviors in the kitchen. A4 wants to use her CricutMaker[2] more often to decorate her personal belongings, but the lack of staff support prevents her from making it a routine. There is limited staff in her community home, even more so with COVID, so she rarely gets to design custom t-shirts (an activity she loves) (Figure 8).

5 DISCUSSION

Our findings presented barriers preventing individuals from regularly practicing their everyday routines. We also described activity patterns about how routines are formed and maintained. This section discusses how participants perceived "difficulty" in doing tasks independently, describes trade-offs in online qualitative research, and outlines a list of design opportunities for future assistive devices.

5.1 Perceptions of Difficulty in Daily Activities

We found that the term "difficulty" can have several interpretations within this community. Some individuals described difficulty as the inability to do activities independently. Individuals who regularly perform activities with caregivers perceived difficulty as obstacles during the shared effort in activities, like discomfort with caregivers. For example, individuals with physical disabilities often socialize with their caregivers during personal tasks, like using the bathroom. This is a comfort strategy to make the activity less awkward and less uncomfortable. Others interpreted difficulty as the lack of

[2]https://cricut.com/en-us/cricut-maker

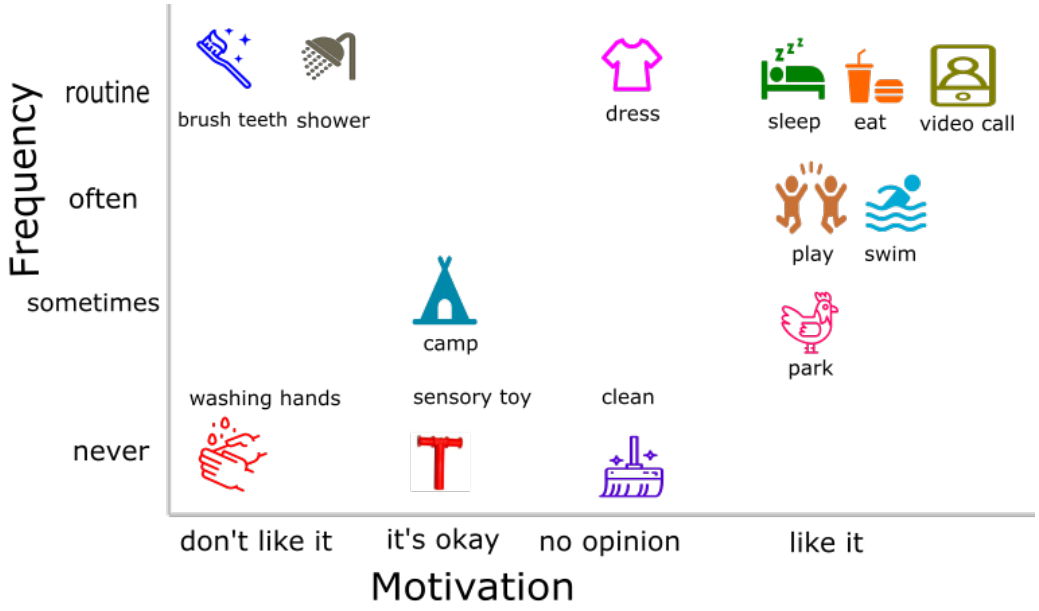

Figure 7: P1's son's activity pattern shows a slightly scattered pattern where well-liked activities mostly become routines. In contrast, disliked activities may or may not become routines depending on other overlapping accessibility barriers.

Figure 8: A4's activity pattern shows that well-liked activities, like art, do not become routines. In contrast, less-liked activities essential to consistent practice often become routines.

motivation to do activities. These divergent interpretations suggest that difficulty may not be just ability based but can overlap with other factors.

Future prompting systems can incorporate features to customize support based on a range of "difficulties." Devices could extend support for accessibility barriers, like stepwise guidance, by providing options to incorporate motivational features, like avatars or games [32]. Furthermore, they could incentivize activities using the anchoring principle — linking their less-liked daily activities with their favorite ones. Systems can also incorporate ice-breaker activities to reduce discomfort between individuals and their caregivers, particularly for wheelchair users.

5.2 Reexamining Goal-Setting Theories

Existing theories on developing behaviors suggest a healthy balance between ability and motivation to form regular practice. However, these models have been primarily designed for neurotypical people and can be less accurate for people with cognitive disabilities. These

models must consider the wide range of abilities and the lack of assistive devices or support within the community. The findings in this paper emphasize expanding goal-setting and routine formation theories to include the needs of people with cognitive disabilities. Researchers must rethink the meaning of regular practice, its impact on independent living, and how it could be an ongoing process for certain people. Some people might always need support while regularly practicing their daily activities.

5.3 Online Design Activities with People with Cognitive Disabilities

Our study taught us that caregivers and people with cognitive disabilities could collaborate and make significant individual contributions concurrently.

There are many trade-offs to conducting online participatory-based design activities with people with cognitive disabilities. This can include 1) individuals not knowing how to manage multiple screens, like navigating the activity screen and the Zoom meeting window, to access links in the chat; 2) individuals not being able to edit the canvas with the proper access settings, and 3) individuals not being able to perform the required gestures or interactions. To overcome these challenges, prior research suggests a competency-based design approach, where we can leverage participant skills in activities during the design process [1]. However, people with cognitive disabilities often have a wide range of competencies. Unless we recruit participants with the exact functional abilities, most online design methods create challenges in balancing design methods and participant abilities. In rethinking methods and options, we found that providing self-design and proxy-design opportunities can be helpful and inclusive.

Structured, choice-based questions within design activities can support individuals with communication devices. For example, P5 chose to self-design but found it difficult to drag and drop post-it notes using his communication device, so we made impromptu changes to our design method and asked A5 to sort post-it notes based on numbers between 1 and 4. We used a combination of self-design and proxy design, where A5 categorized the post-it notes, and we dragged and dropped the notes into appropriate boxes.

5.4 Implications for Future Assistive Devices

Our findings uncovered implications for future devices, including understanding how devices can scaffold prompts during activities and use strategies to overcome accessibility and motivational barriers.

5.4.1 Personalized Scaffolds. Smart devices can expand their capabilities to scaffold prompts by integrating personalized motivations and community support strategies. Systems can motivate individuals to initiate less-liked activities by reminding them about upcoming events. Likewise, this strategy can redirect individuals from specific behaviors, like refusing to sleep or waking up and wearing day clothes at night. A second strategy to scaffold activities is to link their favorite activities with less liked ones using the prevalent *anchoring* or "first-then" approach.

Besides initiation, persistence is another area where devices could motivate individuals. For example, devices could prompt individuals with their favorite music, videos, or other media, particularly for more extended activities like cleaning or organizing laundry. Positive reinforcements can also help individuals feel more confident about activities they dislike. For example, devices can verbally praise individuals or include celebrations as they practice complex tasks, like packing their backpacks with numerous items, cleaning the house, or cooking a meal.

5.4.2 Augmented Tutorials for New Skills. Besides personalized motivational prompts, devices could provide scaffolded tutorials to help individuals learn new activities. We found that many individuals want to develop skills in new daily activities, like making the bed, and hobbies like art, 3D printing, and bowling. For example, A2 finds it challenging to draw flowers and often seeks assistance from his instructor. An assistive device could teach A2 how to draw a flower by augmenting personalized tutorials. Devices could leverage AR to help individuals learn new skills, incorporating effective strategies that caregivers have used, like first-then or anchor favorite mini-activities with each tutorial.

5.4.3 Multi-Role Multi-User Prompting Systems. Multiple stakeholders, like individuals, caregivers, or staff, use assistive devices for different purposes. Individuals with cognitive disabilities primarily use devices to receive prompts. On the other hand, caregivers primarily use assistive devices to create prompts based on their client's needs. They are also tasked with providing feedback to individuals during activities and modifying prompts based on their client's performance. Future devices can integrate capabilities to support customized prompting and review mechanisms for individuals and their caregivers. This can take many forms, like incorporating personalized motivation, customizing prompts in real-time while doing activities, and incorporating a process to review ad-hoc customizations so devices can improve their prompting strategies.

6 CONCLUSION

This paper presents self-reflections of people with cognitive disabilities about their practice of daily routines, where they explain barriers preventing them from regularly practicing activities and discuss strategies to overcome those barriers. We engaged adults with cognitive disabilities, caregivers, and parents in a participatory-based design interview to categorize their everyday activities based on frequency, motivation, and difficulty. We learned that motivation and ability play equal roles in daily activities. Fun and easy activities may not become routines because of the lack of assistive devices, staff shortages, or social skills. Tedious and difficult activities are often part of daily routines because they are essential for achieving autonomy and are strongly supported. Existing goal-setting axioms on developing regular behaviors do not accurately translate to people with cognitive disabilities because of the diverse range of abilities and needs. We also documented several prompting strategies used by this community to manage familiar tasks and teach new ones. These insights can help future smart assistive devices enable people with cognitive disabilities to become more independent and assist caregivers in better-facilitating support during daily activities.

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