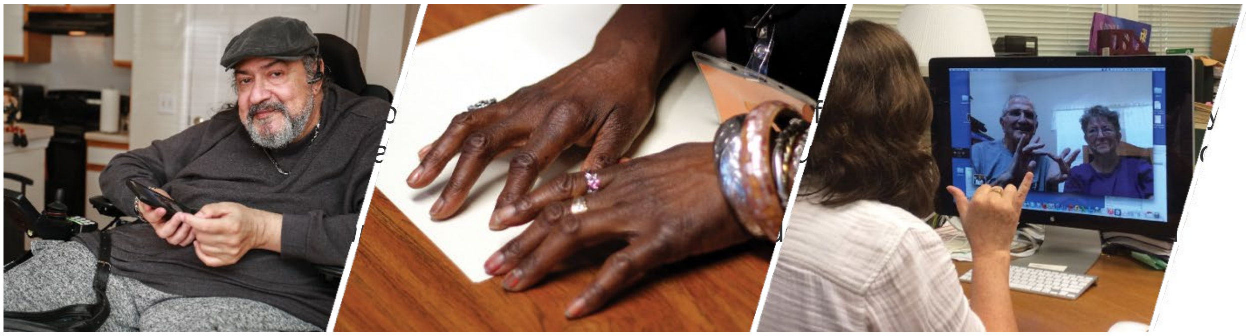

TechSAge Tool: Task Analysis
Rehabilitation Engineering Research Center on Technologies to Support Aging-in-Place for People with Long-Term Disabilities (TechSAge RERC)
TechSAgeRERC.org

Correspondence concerning this report may be addressed to:
| **Wendy A. Rogers** (wendyr@illinois.edu)
| **Tracy L. Mitzner** (tracy@gatech.edu)

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Table of Contents

TechSAge Tools Overview

TechSAge has designed this tool series to provide its readers with guides on how to conduct various aspects of human factors research. The tools have a focus on including the target population of adults aging with disabilities. TechSAge Tools are designed to:

1) Introduce a variety of research methods, procedures, and protocols

2) Provide guides and "how-to" information about implementation

3) Discuss considerations specific to working with adults aging with disabilities

4) If applicable, recommend appropriate wording to describe the method in publications

5) Point to reliable resources for more in-depth information about the method, procedure, ore protocol presented in the tool

This TechSAge tool is designed to give an overview of a variety of types of task analyses, provide a step-by-step to guide to conducting hierarchical task analysis, and offer guidance about using task analyses in the context the TechSAge target population of adults aging with long-term disabilities.

Task Analysis

INTRODUCTION

A task analysis is a tool that can help deconstruct a goal-oriented behavior and better understand what tasks and sub-tasks an individual must perform to achieve the goal. In a task analysis, ordinary users are observed in action to understand the details of how they perform tasks and achieve intended goals (usability.gov, 2016). The results of task analyses can aid in design or redesign of tasks, systems, instructions, environments, and help to improve usability, efficiency, and safety (Adams, Rogers, & Fisk, 2012). Task analyses can be used as a starting point for other human factors approaches, including error analysis, instructional support development, cognitive walkthrough, heuristic analysis. Moreover, they are useful to understand task subcomponents.

In one study, a task analysis was conducted to document the steps required to obtain a reading using a blood glucose meter (Rogers, Mykityshyn, Campbell, & Fisk, 2001). The device was advertised as "simple-to-use" with only three steps. However, a type of task analysis (i.e., Hierarchical Task Analysis) revealed that the "simple-to-use" device in fact had more than 52 sub-tasks (see Figure 1,from Rogers et al., 2001).). These findings demonstrate the value of task analyses; without observation and research, complex tasks can be mistaken for simple tasks creating unnecessary usability challenges.

TASK ANALYSIS FOR A STANDARD BLOOD GLUCOSE METER

Task No.	Task	Task/Knowledge Requirements	Feedback	Potential Problems
1.0	**Set up the meter**			
1.1	Select the display language			
1.1.1	Press and hold the C button	Location of C button	Tactile (feel button action)	Cannot locate button
1.1.2	Press and release the On/Off button	Location of On/Off button	Meter beeps when turned on; meter displays last reading	Cannot locate button Fail to release button
1.1.3	Release the C button	Location of C button	Tactile (feel button action)	Cannot locate button
1.2	Code the meter			
1.2.1	Turn on the meter	Location of On/Off button	Meter beeps when turned on; meter displays last reading	Cannot locate button
1.2.2	Compare the code numbers on the meter and test strip package	Location of correct code number	None	Cannot find correct code number on package
1.2.3	Press the C button until the codes match	Location of the C button	Tactile (feel button action); code changes on display	Enter incorrect code number
2.0	**Check the system**			
2.1	Perform a check strip test			
2.1.1	Make sure the test area is clean	Location of test area	None	Test area not cleaned
2.1.2	Turn the meter on	Location of On/Off button	Meter beeps when turned on; meter displays last reading	Cannot locate button
2.1.3	Wait for meter to say "Insert Strip"	Location of display	Meter displays instructions	Does not observe instructions on display; inserts strip too early
2.1.4	Slide side 1 of the check strip into the test strip holder	Location of the test strip holder; proper orientation of check strip	Meter displays "Apply Sample" when it detects something	Insert check strip incorrectly; insert something other than a check strip
2.1.5	Wait for the meter to say "Apply Sample"	Location of the display; correct procedure	Meter displays instructions	Does not remove check strip from holder; applies blood or control solution; does not wait for instructions
2.1.6	Slide the check strip out of the test strip holder	Correct procedure	Meter displays "Insert Side 2" when strip is removed	Does not remove check strip
2.1.7	Wait for the meter to say "Insert Side 2"	Location of the display; correct procedure	Meter displays instructions	Does not wait for the instructions
2.1.8	Slide side 2 of the check strip into the test strip holder	Location of test strip holder	Meter counts down when it detects something	Insert check strip incorrectly; insert something other than a check strip
2.1.9	Wait for the meter to count down from 4 to 0	Location of the display; correct procedure	Meter displays count and beeps when finished	Does not wait for meter to count down
2.1.10	Observe reading on the meter	Location of the display; indication of satisfactory test	Meter displays calibration result	Fail to observe result and verify it is satisfactory
2.2	Perform a glucose control solution test			
2.2.1	Check that the correct glucose control solution is being used	Correct solution type	None	Incorrect control solution used
2.2.2	Check the expiration date on the control solution vial	Location of expiration date	None	Expired control solution used
2.2.3	Shake the control solution vial vigorously	Correct procedure	Tactile (feel solution mix in bottle)	Vial not shaken; control solution not properly mixed
2.2.4	Turn on the meter	Location of On/Off button	Meter beeps when turned on; meter displays last reading	Cannot locate button
2.2.5	Remove a test strip from the package	Location of packet	Tactile	Unable to open packet
2.2.6	Wait for meter to say "Insert Strip"	Location of display	Meter displays instructions	Does not observe instructions on display; inserts strip too early
2.2.7	Insert test strip into the test strip holder	Location of the test strip holder; proper orientation of test strip	Meter displays "Apply Sample" when it detects something	Insert test strip incorrectly

Figure 1. Task Analysis for a Standard Blood Glucose Meter

Task analysis can be used for applications beyond documenting the sub-tasks of a task, as well. Table 1 presents additional goals that task analysis can be used to achieve. Table 1 also presents examples of these goals in the context of the TechSAge target population (i.e., adults aging with long-term hearing, mobility, or vision disabilities).

Table 1. Goals of Task Analyses and Examples

Goals	Examples
Understand the tasks required to achieve a goal	Track and understand the tasks that a person with a mobility disability needs to accomplish to get to the grocery store (e.g., wake up, get out of bed, change clothes, personal hygiene)
Assess opportunities for support and intervention	Document the subcomponents of a community participation task that provide challenges for a person with a hearing disability to assess opportunities for support and intervention
Understand how task demands vary over the course of a complex task	Determine at what points during a task an individual aging with a disability may need additional assistance to combat cognitive or physical fatigue
Create a detailed visualization of the tasks and sub-tasks of a primary goal	Create a visualization of the tasks that a person who is a wheelchair user would go through to set up a TV
Understand how consumers would use a prototype of a future product	Understand how an older adult with a vision disability would interact with a prototype of a new technology
Detail usability issues with a product to determine how to make improvements	Detail usability issues encountered by an older adult with an upper body mobility disability when navigating through a phone application
Assess which parts or functions of a product design are required or unnecessary	Assess which parts or functions of a blood glucose monitor are required for use by an older adult with a hearing disability to develop targeted instructions for their user group
Perform an error analysis	Document the errors that result when an older adult with a vision disability uses Amazon Alexa and determine whether they are incidental or systematic and widespread

TYPES OF TASK ANALYSIS

There are several types of task analysis, but the primary focus of this report is the Hierarchical Task Analysis (HTA), which analyzes and describes a hierarchy of specific tasks and sub-tasks (i.e., human tasks, system tasks, or a combination) that are performed to achieve a specific goal. HTA is widely considered the most accessible task analysis approach, with the least need for prior expertise and skills. Other types of task analysis may be more applicable depending on the context of the task, investigative needs, and staff expertise. Examples include Cognitive Task Analysis (CTA) and Applied Cognitive Task Analysis (ACTA); Goals, Operations, Methods, and Selection Rules (GOMS); and Ecological Task Analysis (ETA). See Table 2 for an overview of the different types of task analysis, with descriptions, goals, skills/expertise required.

Table 2. Types of Task Analysis

	Description	Goals	Skills/Expertise
Hierarchical Task Analysis (HTA)	Top-down process that results in a hierarchy of tasks that need to be accomplished to achieve a goal	Understand the flow of tasks and shortcomings with no prior training and expertise	Researcher must have extensive knowledge of the tasks being examined
Cognitive Task Analysis (CTA) and Applied Cognitive Task Analysis (ACTA)	Focus on tasks that require a large amount of cognitive work from the user by assessing the underlying mental processes of observable behavior	Generate information on expert performance regarding a specific task	Researcher must have knowledge of cognitive psychology, domain knowledge, and interviewing skills when using CTA, while ACTA only requires domain knowledge and interviewing skills
Goals, Operations, Methods, and Selection Rules (GOMS)	Analyze a user's cognitive knowledge and processes that they engage in to perform and achieve a task	Understand different task pathways and actions one would go through to achieve a goal	Researcher must have knowledge on cognitive psychology, as well as domain knowledge
Ecological Task Analysis (ETA)	Focus on the environmental factors that influences one's actions towards a goal	Understand the constraints of a task goal, environmental conditions, and user characteristics	Researcher must have knowledge of the parameters and measures that are manipulated, as well as a background in cognitive engineering and/or cognitive psychology

Next, we provide high-level descriptions of Cognitive Task Analysis (CTA) and Applied Cognitive Task Analysis (ACTA); Goals, Operations, Methods, and Selection Rules (GOMS); and Ecological Task Analysis (ETA). These sections will be followed by a more in-depth description of Hierarchical Task Analysis (HTA), including a step-by-step guide for conducting an HTA. Lastly, we provide examples of task analyses performed in the context of research on adults aging with long-term disabilities.

COGNITIVE TASK ANALYSIS (CTA) AND APPLIED COGNITIVE TASK ANALYSIS (ACTA)

Cognitive Task Analysis (CTA) is a type of task analysis that focuses on tasks that require a large amount of cognitive processing from the user (Militello & Hutton, 1998). Specifically, it is used to deconstruct how cognitive processing contributes to observable behavior. It is usually performed based on interviews with subject matter experts (SMEs). The expertise of SMEs can provide rich insights into the cognitive processes involved in the task being investigated. Some steps that are included in CTA are the mapping of tasks; identification of critical decision points; assembling, connecting, and sequencing of actions taken; and the characteriziation of the strategies used (Militello & Hutton, 1998). CTA therefore requires expertise in cognitive science as well as ample time and resources. As an alternative, applied cognitive task analysis (ACTA), was developed for nonexperts in cognitive science. ACTA still requires interviewing skills and domain knowledge, but streamlines the process for people without expertise in cognitive science (Adams et al., 2012).

ACTA consists of three commonly used interview methods to obtain critical information regarding the cognitive work and skills that a SME would use to achieve a certain goal (Militello & Hutton, 1998). The first method is the task diagram interview, in which the interviewer is provided with an overview of the tasks and goals, as well as the cognitive approach that one would follow to achieve those goals. This method enables the interviewer to conduct an in-depth interview. The second interview method is the knowledge audit, in which the interviewer identifies the aspects of expertise and understanding that are required to perform a specific task. This interview method is performed to find examples of actions or processes that experts use to successfully complete a task. Such information may include different cues, considerations, and/or heuristics, and a goal of the interview is to understand how they may be important to expertly perform the task. The third interview method is the simulation interview, which allows the interviewer to understand the cognitive processes of SMEs performing a task within the context of a scenario. Information collected from the scenario may include events, actions, assessments, critical cues, and potential errors. The products of all three methods together contribute to a "Cognitive Demands Table" that outlines the contributing cognitive needs, their complexity, purpose, potential errors, as well as the informed approach used by the SME (Militello & Hutton, 1998).

Advantages of CTA/ACTA

- Provides detailed information, including the cognitive processes involved, on expert performance of a specific task of interest
- Recognizes and allows for the capture of cognitive processes that may not be readily observable
- Collects a significant amount of information during a relatively brief period

Disadvantages of CTA/ACTA

- Difficult to understand cognitive processes, thus requires some expertise on the part of the researcher
- Potential for introducing bias during interview and data collection process

Cognitive and Applied Cognitive Task Analysis (CTA/ACTA) Summarized	
GOALS	Used to focus on tasks that require a large amount of cognitive work from the user by assessing the underlying mental processes of observable behavior. • To identify characteristics of expert performance regarding a specific task. • To determine the cognitive processes performed by a task expert.
METHODS	Interview (Cognitive Demands Table) • Task Diagram Interview • Knowledge Audit • Simulation Interview

GOALS, OPERATIONS, METHODS, AND SELECTION RULES (GOMS)

GOMS (Goals, Operations, Methods, and Selection Rules) is a type of task analysis that deconstructs a task to understand an experienced user's relevant cogntiive structure and the contributing procedural knowledge necessary for successful task completion. It was first introduced in the context of human-computer interaction (Card, Moran, & Newell, 1983). GOMS is commonly used for computer or interface-related tasks to understand how a user reaches a specific goal. GOMS represents *Goals* that are achieved through *Methods,* which consist of a series of steps called *Operations.* The example below shows the *Operations* and *Methods* one would go through to turn on smart lights (*Goal*) using a digital home assistant (Amazon Echo Show). If there is more than one *Method* that is needed to achieve the *Goals,* one would include the *Selection*

Rules that are used to choose one of the *Methods* depending on the context. In the example below, there are two *Methods* possible to achieve the *Goal* of turning on the smart lights. Therefore, the *Selection Rules* will be applied and one can, in this example, choose between the two *Methods,* using the Echo Show with voice control or using the Alexa app, to move forward with the *Operations.* One important feature of GOMS is the 'how to do it' knowledge is described in such a way that the task can be executed (Kieras, 1994). In the example presented, the *Operations* ('how to do it' knowledge) are described in detail for turning on the smart lights, allowing a person reading through it to perform the tasks with ease. Thus, one should the be able to go through GOMS step-by-step and complete the goals through the methods mentioned.

<u>Example of GOMS</u>

- **Goal**: Turn on the smart lights
- **Method**: Two methods below
- **Operations**: Steps for each method
- **Selection Rules**: Whether it will be through the Alexa app or the Echo Show

Method for goal: Turn on the Smart Lights with Echo Show using voice control

Step 1. Position yourself within range of the Echo Show
Step 2. Say "Alexa, turn on the lights"
Step 3. Wait until Alexa says "Light on"
Step 4. Accomplish goal: Turn on the smart lights

Method for goal: Turn on the Smart Lights with the Alexa App

Step 1. Tap on the Alexa app
Step 2. Tap on "Devices" on the bottom right
Step 3. Tap on "Lights" on the top
Step 4. Tap on the light you need to turn on
Step 5. Tap on power button
Step 6. Accomplish goal: Turn on the smart lights

Selection Rules for goal: Turn on the smart lights

If using your Echo Show: Turn on the Smart Lights with voice control
If using your smart device: Turn on the Smart Lights with the Alexa App

To perform a GOMS analysis effectively, it is recommended that the analyst has some background in cognitive psychology and domain knowledge. In this aspect, GOMS may require a greater level of skill to perform than HTA. However, compared to HTA, GOMS produces a more detailed assessment of the task (i.e., the methods that are used to achieve the goals). GOMS and HTA can be integrated such that GOMS can be used to provide additional detail for a sub-goal of a task identified within a HTA.

For an example specific to older adults and technology, see Jastrzembski and Charness (2007), in which they applied GOMS to estimate task completion times for a mobile phone for younger and younger adults.

Advantages of GOMS

- Describes different task paths or ‘Methods’
- Provides increased understanding of the procedural knowledge involved in completing a task or working towards an outcome
- Assists designers in choosing one of multiple systems by estimating performance and learning times

Disadvantages of GOMS

- Only applicable to users with ample experience with the task
- Requires significant training and can be time-consuming to perform
- Does not account for the presence of potential errors or the mental workload one may experience during the task
- Usually limited to the human-computer interaction (HCI) domain

Goals, Operations, Methods, and Selection Rules (GOMS) Summarized	
GOALS	Used to analyze the user’s cognitive knowledge and processes that they go through to perform and complete a task. • To understand multiple potential task paths one would perform to achieve a goal. • To analyze the performance times and learning time for further development of systems. • To create a hierarchical description of the tasks.
METHODS	• Observe someone performing a task and document everything they do using a computer or paper and pencil. • Use a timer to record the time it takes to perform a method or task. • Assess the cognitive processes that one executes to perform a task.

ECOLOGICAL TASK ANALYSIS (ETA)

Ecological Task Analysis (ETA) is a type of task analysis that focuses on the environmental context and how it affects task performance. The term ETA was coined and developed in two different domains. First, in physical education, wherein the teacher would apply the ETA during training to assess and instruct motor skills (Davis & Burton, 1991). Second, in cognitive engineering wherein one could predict the types of cognitive activity required for productive behavior and how interfaces can be manipulated to ease cognitive demands (Kirlik, 1995). In both domains, the environmental context of the task was considered the constraining problem.

In the physical education domain, the solution to the environmental barrier is skill development. For example, a running coach could use ETA to assess improvement in speed, cardiovascular health, and endurance. In this example, an ETA might be conducted to assess whether practicing running on a field, on grass, or on a treadmill leads to the most improvement. This type of ETA requires expertise about the skills required to navigate the environment's parameters. A benefit of this type of ETA is that it recognizes that there are several paths leading toward a goal. One differing characteristic of this type of ETA is that it is not completed before the task is executed. Instead, it is a real-time analysis conducted during the task (e.g., physical training). As such, it relies on previous literature or results from related research to identify potential task and person dimensions that could influence overall task performance.

In the cognitive engineering domain, the solution to the the environmental barrier is dependent on the person conducting the task. A skilled person is thought to maneuver and restructure the environment to their own ability to find a solution to a cognitive task. For example, a research team might have a task goal of reducing the cognitive load necessary for use of a novel speedometer that is designed to improve utility when compared to traditional speedometer interfaces (i.e., analogue and digital). The task goal itself could then be defined as obtaining a certain accuracy from a broad range of user. The environmental conditions could be the manipulation of the different types and locations of the speedometers within the vehicle, as well as environmental considerations (e.g., time of day). The performer characteristics could include the varying levels of driving experience and expertise, as well as other relevant demographic considerations that might relate to driving performance. In this example an ETA would be conducted to assess the constraints of this interface regarding actual comprehension, attention, cognitive load, and awareness of one's speed. This type of ETA requires expertise in cognitive engineering and cognitive psychology. A benefit of this type of ETA is that it focuses on the methods an expert uses to execute a task by including and structuring their environment.

Advantages of ETA

- Focuses on the constraints of the task goal, environmental conditions, and performer characteristics

- Recognizes that there are several paths leading toward a goal
- Can be used to document tasks performed to reach a goal or tasks performed as a part of a method
- Can be conducted during task training to identify the potential variables that are impacting the individual's task performance

Disadvantages of ETA

- Relies on previous research for relevant task and person dimensions that relate to task performance
- No specific formal final output or product as with other task analyses

Ecological Task Analysis (ETA) Summarized	
GOAL	Used to analyze the environment and how it affects task performance • To understand the constraints of, and potential contributors to, the task goal, environmental conditions, and person characteristics • To assess and instruct motor skills (e.g., for physical education)
METHODS	• Rely on tables published from previous research for relevant task and person dimensions that influence one's performance • Measure performance in varying environmental contexts

HIERARCHICAL TASK ANALYSIS (HTA)

A Hierarchal Task Analysis (HTA) is a tool used to analyze and describe a set of specific tasks and sub-tasks (human tasks, system tasks, or a combination) that are performed by an individual to achieve a specific goal. HTA has two main focuses: hierarchical (i.e., task and sub-task actions) and functional (i.e., emphasis on goals over actions). It was first documented to analyze complex tasks (e.g., non-repetitive and cognitively demanding), thereby overcoming the limitations of classical time-and-motion methods (Annett, 2003). It was initially used to develop training process tasks in the steel industries. HTA was further developed by others to understand how to improve human performance in work and recreational settings (Shepherd, 2000). HTA has been applied in diverse fields including human factors, industrial/organizational psychology, aviation, instructional design, programming, and can be applied to personal use as well.

A benefit of HTA is that it does not require any significant prior training or expertise for use. The main requirements are the need to be familiar with the full scope of the task being analyzed, as well as the end-product of an HTA (i.e., hierarchical diagram). It can also be helpful to become familiar with different examples of HTA before using it for a specific need or context. Given the minimal expertise required and diverse areas of potential application, HTA can be useful for many research and development projects. In the following section, we present examples to guide new users of HTA in completing an HTA analysis in an efficient and effective manner. We recommend that multiple observers are included in performing an HTA to ensure that it is comprehensive, and that no steps are missed. Moreover, we recommend audio or video recording the task process, as well as performing the task in an environment that closely matches the expected task environment as possible to support validity of the HTA.

Advantages of HTA

- Simplistic method that can be use by individuals with varying levels of expertise
- Can be used to identify procedural inefficiencies, opportunities for intervention, and steps to be taken to reduce the potential for error
- Can provide a useful task hierarchy that can facilitate the quick and effective understanding of an analyzed task

Disadvantages of HTA

- Lack of standardized rules for creating HTA diagrams and deconstructing tasks
- Potential for interindividual variability between hierarchical diagrams produced by different observers
- Complex tasks may create hierarchical diagrams that are difficult to interpret (i.e., overly complex)

Hierarchal Task Analysis (HTA) Summarized	
GOALS	Used to analyze and describe a set of specific tasks and sub-tasks performed to achieve a specific goal. • To understand the flow of tasks and shortcomings • To develop a detailed diagram for visualizing the tasks of a primary goal • To use as a starting point for other Human factors analyses
METHODS	• Record someone performing a task using audio or video recording • Use paper and pencil to create first draft of a diagram of high-level tasks to achieve the goal, adding sub-tasks as needed • Use word processing, spreadsheet, or graphic software, to develop further versions

Example of HTA

Next, we present a simple example of an HTA to depict the process of making a photocopy of an A4 sheet of paper physically using a printer that requires a PIN code.

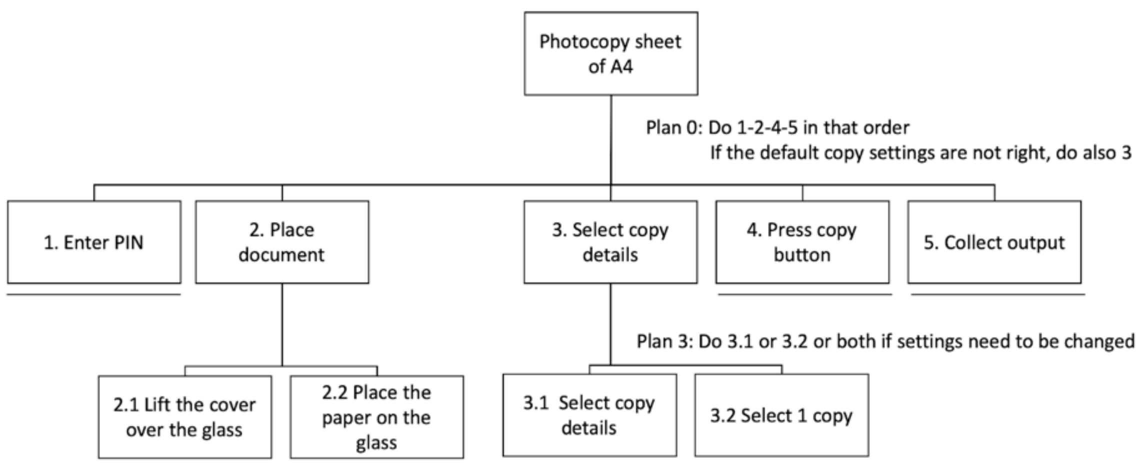


Figure 2. An example of an HTA for photocopying an A4 sheet.

In Figure 2, an HTA was conducted to identify the tasks and sub-tasks for photocopying a sheet of A4 paper. Note that the Plan 0 subtext describes the procedural order or decision-making context for completing the relevant tasks. The individual performing the task should proceed from Step 1 to Step 5 in order, only completing Step 3 if they must modify the copy settings. Subtext is common within HTAs so users are aware of all important considerations at each step during the procedure. Thus, following the entry of the PIN number to access the copy machine, the user then proceeds to Step 2 in which they place the document into the copier by lifting the cover over the glass (2.1) and then placing the paper on the glass itself (2.2). As referenced in Plan 0, if copy settings must be adjusted, Step 3 is then followed. Plan 3 makes it clear to the user that either or both sub-steps should be followed depending on the user's needs for the copy details. Following confirmation that the copy settings are properly selected, the user then moves to Step 4 which involves pressing the copy button to initiate the copy. The output, which is the completed copy, is then collected from the machine.

This example is useful for understanding how HTA depicts a relatively simple task. Next, we present an example with more complexity and a richer context.

Contextualizing HTA with the TechSAge Target Population

The next example was designed to provide an understanding of how HTA can be applied in the context of adults aging with disabilities to understand task barriers and task challenges. The results of this HTA can be used to determine the design and development of appropriate supports to improve task performance. Figure 3 presents a persona to describe the example and context for the task of medication management. Carol is 82 years-old and has been living with a mobility disability for nearly a decade.

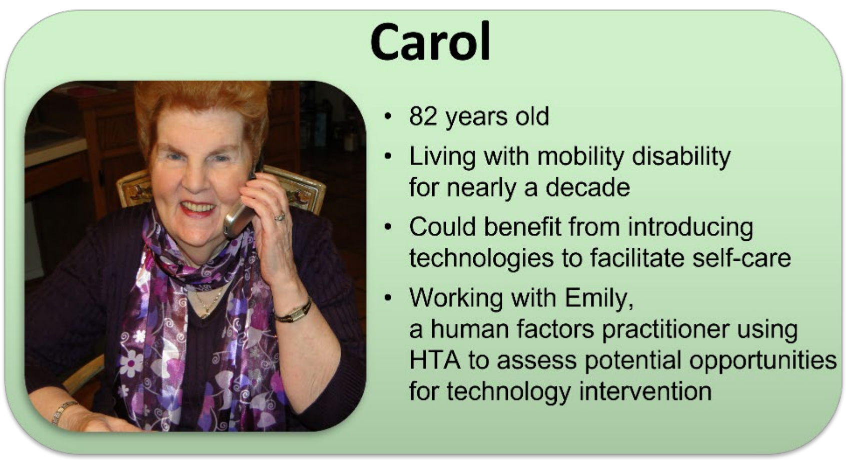


Figure 3. Persona of an older adult living with a disability.

Emily is a human factors practitioner with a goal of reducing the challenges Carol experiences in her everyday life. Emily would like to determine what technology supports might help Carol in performing tasks in her morning routine. Once Emily is able to understand which tasks or sub-tasks present barriers for Carol, she can then determine which characteristics of the tasks are challenging and what technology supports are appropriate. Thus, Emily has decided to perform a task analysis to identify key areas for technology intervention for those tasks. Emily talked to Carol about this approach, who was happy to hear about the goal, as it is one of the most important components of Carol's self-management, Emily is especially interested in understanding how Carol manages her medication throughout the day. She would like to use the HTA to learn at which points throughout the day she can intervene with smart devices that can remind Carol to take her medication.

Figure 4 presents the diagram of an HTA similar to what Emily would create to identify the steps for managing medication. An important way to note procedural or contextual decision-making information in an HTA is to add subtext next to the step (e.g., “Plan 1. Do 1.1, 1.2”). In Figure 4,the subtext adds detail regarding whether the steps are done before sleeping, after waking up, or whether they are done simultaneously.

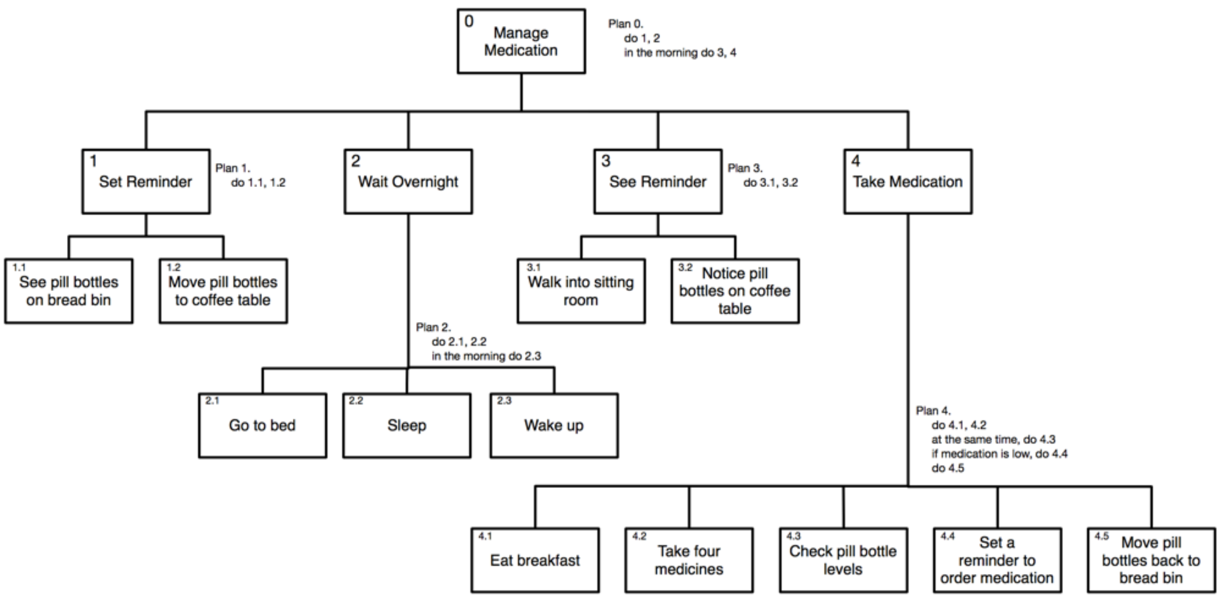


Figure 4. An example of an HTA for medication management.

Next, Emily would like to perform a task analysis to investigate the steps Carol takes whenever she notices that there was a medication omission. Carol has expressed that she has difficulty remembering all the steps she has to complete when she forgets her medication. Emily, therefore, would like to explore which sub-tasks can be simplified or removed. In Figure 5, a Hierarchal Task Analysis (HTA) was conducted to identify the steps for recognizing a medication omission error. The examples in Figures 4 and 5 were conducted during the development of MEDSReM© (see Al-Saleh et al., in press), the Meidcation Education, Decision Support, Reminding, and Monitoring System.

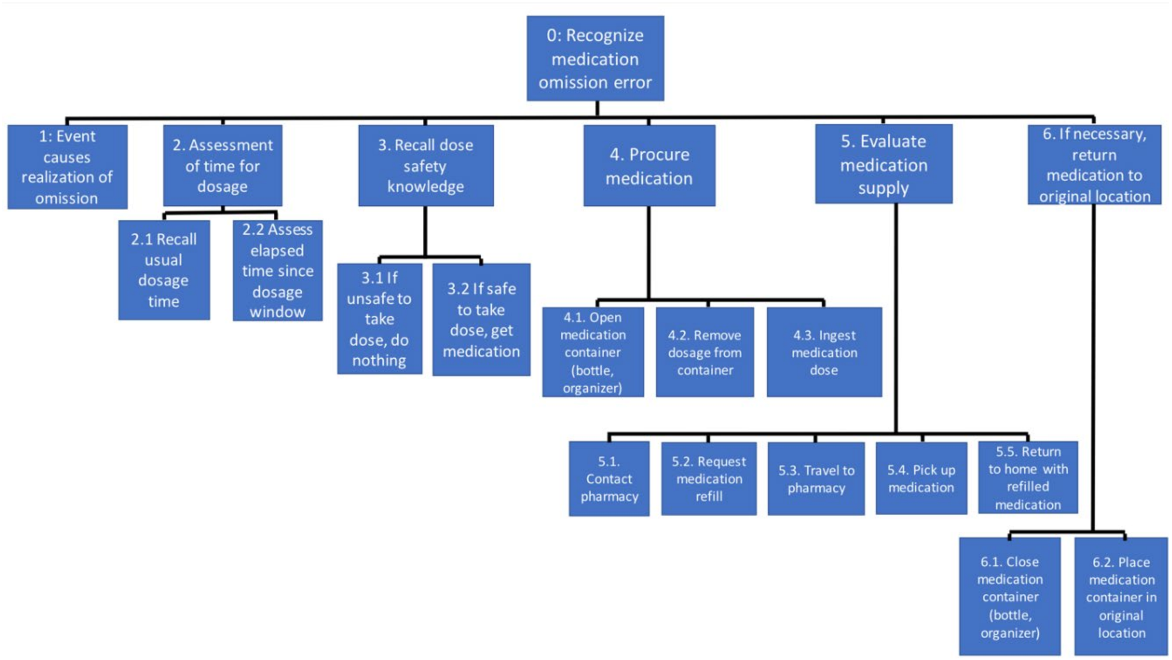


Figure 5. An example of an HTA for a hypertension reminder application.

The preceding examples demonstrate the utility of hierarchical task analysis to fully deconstruct a task and allow a comprehensive understanding of the potential behavioral and decision-related paths that one can execute to perform the task. HTA can be used across many domains with a diverse set of potential behaviors or actions. In other words, if a task has a process and flow, it can be successfully depicted using HTA. With the results of the HTAs, Emily can devise potential avenues of intervention to assist Carol with these tasks, as well as use similar approaches as necessary for any other areas in which Carol would benefit from assistance. For example, Emily found that Carol would sometimes forget to move her medication to the bread bin which is an initial step in helping her remember to take her medication. Emily then decided to install a smart light within the lamp next to Carol's bread bin that would turn on an hour before Carol goes to bed. Turning off the light can remind Carol to prepare her medication for the next day and can help Carol stay consistent with preparing her medications each night, improving her adherence. Because Emily found that Carol could use some assistance with tasks involving memory, she decided to investigate other memory-intensive tasks that could be improved through intervention. Examples included remembering important dates and appointments, managing her finances, as well as remembering to stay physically active each day – all of which can be approached through the use of HTA to help deconstruct and understand each task.

<u>How to Conduct a HTA: Step-by-Step Guide</u>

Next, we will present step-by-step instructions for conducting a HTA. In this guide, we will be using an example of Emily creating an HTA of Carol managing her medication.

1. Define and understand the tasks and overall goal to be analyzed.

<u>Overall Goal:</u> To understand the tasks required for Carol to take her medication.

2. Collect data such as the sub-tasks of the tasks with specific detail.

   Emily stays next to Carol throughout the day to see what she does step-by-step to take her medication. She makes sure she gets all the information she needs by taking notes and recording the process with Carol's consent.

3. Determine and write down the overall goal of the tasks. You may already know this due to Step 1.

   Emily already knows the overall goal of the HTA as it is the process Carol goes through to take her medication.

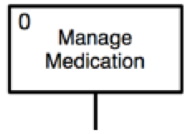
4. Determine the sub-goals that are done to achieve the overall goal.

   Sub-goal 1: Set reminder
   Sub-goal 2: Wait overnight
   Sub-goal 3: See reminder
   Sub-goal 4: Take medication

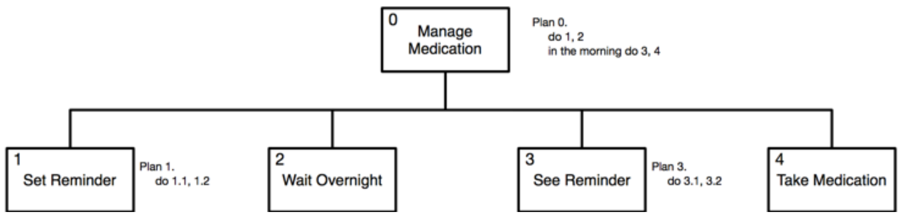
5. Break down the sub-goals into smaller sub-tasks and keep doing this until every detail that is necessary to perform the tasks is present.

   Sub-task 1.1: See pill bottles on bread bin
   Sub-task 1.2: Move pill bottles to coffee table
   Sub-task 2.1: Go to bed
   Sub-task 2.2: Sleep
   Sub-task 2.3: Wake up
   Sub-task 3.1: Walk into sitting room
   Sub-task 3.2: Notice pill bottles on coffee table
   Sub-task 4.1: Eat Breakfast
   Sub-task 4.2: Take four medicines
   Sub-task 4.3: Check pill bottle levels
   Sub-task 4.4: Set a reminder to order medication
   Sub-task 4.5: Move pill bottles back to bread bin

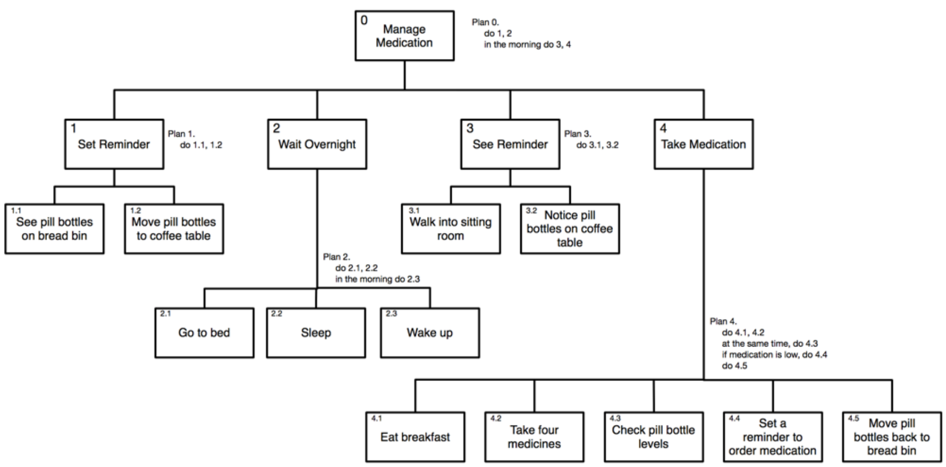
6. On a new paper, start a bracket with the overall goal on top.



7. Below the overall goal, create sub-brackets of the sub-tasks.



8. Below the sub-tasks, document all of the smaller sub-goals and notate every detail that was documented in step 5.



9. Your Hierarchical Task Analysis is now complete!

If you would like to learn more about HTA, there are resources below including links to websites with detailed descriptions of the process, relevant considerations, as well as examples.

HTA Resources:

- For a Short Overview of HTA: Hierarchical Task Analysis by AHRQ
- For a Detailed Description of HTA: Hierarchical Task Analysis
- For the Developments, Applications, and Extensions of HTA: Hierarchical task analysis: Developments, applications, and extensions
- For HTA and Training Decisions: Hierarchical Task Analysis and Training Decisions
- For Practitioners: Choosing the Right Task Analysis Tool (Adams, Rogers, & Fisk, 2012)

SUMMARY

The goal of this TechSAge Tool was to introduce task analysis as a method that can be used deconstruct and understand tasks in the research context. In particular, we described how task analyses can be used to identify opportunities for support and interventions for the TechSAge target population: adults aging with sensory or mobility disabilities. We provided brief introductions to the most common forms of task analysis including Cognitive (and Applied Cognitive) Task Analysis; Goals, Operations, Methods, and Selection Rules; Ecological Task Analysis; and Hierarchical Task Analysis. For each, we described the background, necessary skills, as well as important considerations when utilizing such approaches. We provided an in-depth review of hierarchical task analysis (HTA), considered one of the most approachable forms of task analysis that can be used by practitioners across diverse fields to effectively understand a process or behavior. We then contextualized the use of HTA with the persona of an older adult living with mobility disability to gain an understanding of how an intervention could best support task performance. We provided a step-by-step approach for conducting an HTA and identified additional resources for learning more about HTA. This tool can be used by researchers to select an appropriate task analysis approach and to conduct an HTA, even without prior experience doing so. In the context of TechSAge, the results can be used to identify user needs and to guide technology interventions to support people aging with long-term disabilities.

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