Comments from Stefan Johansson, [Stefan.johansson@funkanu.se](mailto:Stefan.johansson@funkanu.se), consultant at [Funka Nu](http://www.funkanu.se) and researcher on cognitive accessibility at [KTH](http://www.kth.se) - Royal Institute of Technology, CSC – School of Computer Science and Communication. Member of ISO ISO/TC 173.

Comments compiled from discussions within the Swedish project Begripsam. [The Begripsam project](http://www.fungerandemedier.se/?q=begripsam) is managed by 3 Swedish disability organizations for persons with dyslexia, dyscalculia, autismspectrum disorders, adhd, language disorders and intellectual disorders.

We have general comments on the document and specific comments on the Dyslexia chapter. We have not been able to work through other diagnose-chapters due to lack of time.

**Cognitive Accessibility User Research**

**W3C First Public Working Draft 15 January 2015**

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**Abstract**

Cognitive Accessibility User Research describes the challenges of using web technologies for people with learning disabilities or cognitive disabilities. The research describes challenges in the areas of attention, executive function, knowledge, language, literacy, memory, perception, and reasoning. It is organized by user groups of the following disabilities: Aging-Related Cognitive Decline, Aphasia, Attention Deficit Hyperactivity Disorder, Autism, Down Syndrome, Dyscalculia, Dyslexia, and Non-Verbal. Additional user groups may be added to future versions. This document provides a basis for subsequent work to identify gaps in current technologies, suggest strategies to improve accessibility for these user groups, and develop guidance and techniques for web authors.

**Comment**: The idea of organizing difficulties by diagnoses must be questioned. We can easily find 100 diagnoses where cognitive issues can be found. In our opinion we don’t need to describe diagnoses to learn what to do to make something cognitive accessible. Diagnoses are more useful in health care and medicine. Instead of describing diagnoses this document should refer to recognized resources (in our opinion ICF, ICD 10 or [DSM IV](http://www.dsm5.org)).

A huge job has been done on classification by the WHO and [the ICF classification system](http://www.who.int/classifications/icf/en/). It is essential to understand the difference between diagnose, disability, impairment and other well defined terms.

On http://www.w3.org/WAI/intro/people-use-web/diversity#visual we get descriptions according to disabilities/impairments, not diagnoses. On that page we can learn about problems with vision. The page does not present Glaucoma, Retinal detachment and a number of other diagnoses and how people with each and every diagnose use the Web. It is no point doing that. The issue for web accessibility is to present solutions for persons with low vision, not for persons with specific diagnoses. It is exactly the same in the cognitive area. We need to know about the cognitive impairments rather than the diagnoses. For example: attention problems are present in a number of diagnoses. To solve problems about attention we should focus on attention not diagnose. So, it is better to focus on how different cognitive impairments should be dealt with. If you want to provide descriptions on diagnoses please refer to ICD 10 or DSM IV, rather than make own descriptions.

There are a large number of statements that we belive can be seen as questionable in this document. In next version it would be a good thing that statements are properly refered to, so that an interested reader more easily can read the reference for themselves.

**Status of This Document**

*This section describes the status of this document at the time of its publication. Other documents may supersede this document. A list of current W3C publications and the latest revision of this technical report can be found in the* [*W3C technical reports index*](http://www.w3.org/TR/) *at http://www.w3.org/TR/.*

This is a First Public [Working Draft](http://www.w3.org/2004/02/Process-20040205/tr.html#RecsWD) by the [Cognitive and Learning Disabilities Accessibility Task Force](http://www.w3.org/WAI/PF/cognitive-a11y-tf/) (COGA TF), a joint task force of the [Protocols and Formats Working Group](http://www.w3.org/WAI/PF/) (PFWG) and the [Web Content Accessibility Guidelines Working Group](http://www.w3.org/WAI/GL/) (WCAG WG) of the [Web Accessibility Initiative](http://www.w3.org/WAI/). This first version shows the research collected to date and will be the basis for future work on addressing accessibility of web content to people with cognitive or learning disabilities. The task force intends eventually to publish this document as a Working Group Note.

This first public working draft is comprehensive, but preliminary. The task force invites review for accuracy and completeness, as well as understandability. The task force also seeks editorial input into structure and content. Suggestions for content to address other user groups is also welcomed, although some groups may only be addressed in later stages of the work.

To submit comments, send email to [public-coga-comments@w3.org](mailto:public-coga-comments@w3.org) ([comment archive](http://lists.w3.org/Archives/Public/public-coga-comments/)). Comments may also be filed as issues or pull requests in the [GitHub repository](https://github.com/w3c/coga), submitting different comments in different issues or pull requests to allow them to be processed separately. Comments should be made by **13 February 2015**. In-progress updates to the document may be viewed in the [publicly visible editors' draft](https://w3c.github.io/coga/user-research/). A history of changes is available in the commit history of the GitHub repository.

Publication as a First Public Working Draft does not imply endorsement by the W3C Membership. This is a draft document and may be updated, replaced or obsoleted by other documents at any time. It is inappropriate to cite this document as other than work in progress.

This document was produced by a group operating under the [5 February 2004 W3C Patent Policy](http://www.w3.org/Consortium/Patent-Policy-20040205/). The group does not expect this document to become a W3C Recommendation. W3C maintains a public list of any patent disclosures ([Protocols and Formats Working Group](http://www.w3.org/2004/01/pp-impl/35422/status), [Web Content Accessibility Guidelines Working Group](http://www.w3.org/2004/01/pp-impl/32212/status)) made in connection with the deliverables of the group; that page also includes instructions for disclosing a patent. An individual who has actual knowledge of a patent which the individual believes contains [Essential Claim(s)](http://www.w3.org/Consortium/Patent-Policy-20040205/#def-essential) must disclose the information in accordance with [section 6 of the W3C Patent Policy](http://www.w3.org/Consortium/Patent-Policy-20040205/#sec-Disclosure).

This document is governed by the [1 August 2014 W3C Process Document](http://www.w3.org/2014/Process-20140801/).

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**1. Introduction**

*This section is non-normative.*

This document provides background research on user groups with learning disabilities and cognitive disabilities; and challenges they face when using Web technologies. We aim to identify and describe the current situation so subsequent publications can contrast it to what we want to happen.

This document will be used as a base document to enable the task force to perform a gap analysis; suggest techniques; and create a road-map for improving accessibility for people with learning disabilities and cognitive disabilities.

It is currently at its first draft. We are asking for comments. Please let us know if you are aware of omissions.

**Comments**

The document needs extensive rework to be used as a base document. According to our opinion it is not a good idea to follow a “diagnose path” to solve cognitive issues.

**1.1 Importance of This Document**

This document is important because enabling people with learning and cognitive disabilities to use the Web and Web technologies is of critical importance to both individuals and society.

More and more, the Internet and the Web have become the main way people stay informed and current on news and health information; keep in touch with friends and family; and provide independence such as convenient shopping etc. People who cannot use these interfaces will have an increased feeling of having a disability and of being alienated from society.

Further, with the advent of the Web of Things, everyday physical objects are connected to the Internet and have Web interfaces. Being able to use these interfaces now is an essential component of allowing people to maintain their independence, stay in the work force for longer, and stay safe.

Consider that the population is aging. By 2050, it is projected there will be 115 million people with dementia worldwide. It is essential to the economy and society that people with mild and moderate levels of dementia stay as active as possible, and participate in society for as long as possible. However, at the moment, even people with only a mild cognitive decline may find standard applications impossible to use. That means more and more people are dependent on care givers for things that they could do themselves, increasing the crippling cost of care and reducing human dignity.

We therefore invite you to review this draft; and comment and consider how your technologies and work may be affected by these issues.

**1.2 Assumptions**

There is a huge number of cognitive disabilities and variations of them. If we attempt an analysis of all the possibilities, the job will be too big, and nothing will be achieved.

**Comment**: There is a huge number of cognitive diagnoses but the number of cognitive impairments is not that big. Most cognitive difficulties (regardless of diagnose) can be found in the following areas http://apps.who.int/classifications/icfbrowser/;

* orientation (time, place, person)
* intellectual
* psychosocial
* temperament and personality
* energy and drive
* attention
* memory
* emotion
* perception
* thought
* abstraction
* organization and planning
* time management
* cognitive flexibility
* insight
* judgement
* problem solving
* language
* calculation

Therefore, we are adopting a phased approach, selecting in phase one a limited scope of eight diverse disabilities, and hope to achieve something useful within that scope. Also note that helping users improve skills, and emotional disabilities, are out of scope for phase one. We anticipate this analysis will continue to a second or third phase where more user groups are analyzed, and the existing analyses are updated with new research and with new technologies and scenarios.

**Comment**: A more fruitful approach could be a limited scope of impairments from the list above. If we can produce guidelines on how to provide for accessible solutions for attention, memory, perception, abstraction, organization and planning and time management it would be really useful for any user, diagnosed or not.

**1.3 Comments**

This is an early and incomplete draft for review; and to help us get comments and early feedback. We are particularly interested in:

* omitted challenges, use cases, and issues;
* issues involving your technologies/work and people with learning and cognitive disabilities; and
* other omitted research.

We welcome comments and suggestions. Please send comments to pubic-coga-comments@w3.org. All comments will be reviewed and discussed by the task force. Although we cannot commit to formally responding to all comments on this draft, the discussions can be tracked in the task force minutes.

**2. Summary of User Groups and Cognitive Function**

Different people with cognitive disabilities may have problems in the following areas:

**Comment**: It is of great importance to follow established terms and definitions. Se earlier comment on ICF

* **Memory** - Including: Working Memory, Short-Term Memory, Long-Term Memory, Visual Memory, Visuo-spatial Memory, Auditory Memory (memory for sound patterns and others).
* **Executive Functions** - Including: Emotional Control and Self-Monitoring; Planning/Organization and Execution; and Judgment.
* **Reasoning** - Including: Fluid Reasoning (logical reasoning), Mathematical Intelligence, Seriation, Crystallized Intelligence, and Abstraction.
* **Attention** - Including: Selective Attention, and Sustained Attention.
* **Language** - Including: Speech Perception, Auditory Discrimination, Naming Skills, and Morphosyntax.
* **Understanding Figurative Language** - Including: similes, personification, oxymorons, idioms, and puns.
* **Literacy** - Depends upon functions including: Speech Perception, Visual Perception, Phoneme Processing, and Cross-Modal Association (association of sign and concept).
* **Other Perception** - Including: Motor Perception, Psychomotor Perception.
* **Knowledge** - Including: Cultural Knowledge, Jargon (subject matter); Web Jargon and Technology; Metaphors and Idioms; Symbols Knowledge (such as icons); and Mathematical Knowledge.
* **Behavioral** - Including: Understanding Social Cues.

For more information, please see section 5.

It is important to note that people may have limitations in one area and not in other areas. For example, a person with dyslexia may have above-average reasoning, but impaired visual memory and literacy skills. A person with Down Syndrome may have an above-average visual memory, but impaired judgment.

**Comment**: We do not comment on the large summarizing table in this document. But there are conclusion presented in that table that we believe is not correct.

**3. Research on User Groups**

This section describes the state of the art in classification of cognitive function.

**Comment**: State of the art is classified by WHO within the ICF-system. It is a global recognized classification system. Diagnoses are classified in ICD or in DMV IV. This document should referer to and use those classifications.

User group research modules follow. This is Phase 1. The group hopes to add more groups such as effects of Post-Traumatic Stress Disorder (PTSD) on cognitive function.

**3.1 Dyslexia**

Dyslexia is a syndrome best known for its effect on the development of literacy and language-related skills. There are a number of different definitions and descriptions of dyslexia. The syndrome of dyslexia is now widely recognized as being a specific learning disability of neurological origin. It does not imply low intelligence or poor educational potential. It is independent of race and social background.

**3.1.1 Cognitive Functions**

**Comment**: Why is this important in a web accessibility perspective? Do we really need to know this or should we focus on the fact that persons with dyslexia have problems with reading and writing and if we solve reading and writing issues for dyslectics we probably solve problems for a number of persons having the same problems but not a dyslexia-diagnoze?

If this is imprortant: Why can’t we found a lot of stuff about the reasons behind why people have hearing problems on the W3C-pages.

This section is a technical reference. Jump to the next section on [#Symptoms](https://www.w3.org/WAI/PF/cognitive-a11y-tf/wiki/Gap_Analysis/Dyslexia#Symptoms) for more practical information.

**Overview:** Mainstream credible research in behavioral neurology agrees that dyslexia is a consequence of an altered neural substrate in the various regions of the brain responsible for the reading process. fMRI scans (18, 19) have shown different subgroups of dyslexia exhibit under-activity in areas such as:

* V5/MT (BA Area 19) - resulting in visual discriminatory problems (9, 15), possibly disturbing magnocellular function (41);
* auditory cortex (BA areas 41 and 42) - resulting in low auditory-discrimination skills (32);
* superior-temporal gyrus (BA Area 22) Wernike's area and striate cortex or V1 (Area 17) - resulting in a phoneme processing problem (5, 22, 23), and pattern recognition;
* the angular gyrus (Area 39) in the inferior parietal lobule - causing poor cross-modal associations (22, 24, 28, 30).

Other studies (42) using PET have shown less activation than the controls in left-inferior frontal gyrus (BA areas 45, 44, 47, 9), left-inferior parietal lobule (BA area 40), left-inferior temporal gyrus/fusiform gyrus (BA areas 20/37), and left-middle temporal gyrus (BA area 21). There are also studies with different approaches, such as identifying ectopias clustered round the left temporoparietal language areas. (44)

Different schools of research have championed different neurological bases of dyslexia and its resulting subgroups.

**3.1.1.1 Auditory Discrimination**

(Main research - see Tallal et all (32).) This body of research has shown that many people with dyslexia have defects in the left-auditory cortex. The auditory cortex is responsible for sound naming and identification; and temporal processing (such as interval, duration, and motion discrimination).

Note that dyslexia does not affect hearing, but the identification and differentiation of sounds.

**3.1.1.2 Visual Recognition Skills**

(Main school of research Livingstone (1993) and Martin and Lovegrove 1988). See 9, 15.) People with dyslexia have reduced synaptic activity in the V5 area (also known as visual area MT, middle temporal), which is a region of extra-striate visual cortex thought to play a major role in the perception of motion.

V5 is part of the broader "magno-cellular -- large cell -- system" that processes fast-moving objects, and brightness contrasts. One interpretation is that a specific magno-cellular cell type develops abnormally in people with dyslexia (3).

For results of clinical tests see (1).

**3.1.1.3 Phoneme Processing**[**§**](http://www.w3.org/TR/coga-user-research/#phoneme-processing)

Main research from Shaymitz (1998) and Rumsy (1996). (See 5, 10, 11, 14 – 17.) The language regions in the superior-temporal gyrus (Wernike's area) and striate cortex are found to underachieve in people with dyslexia. These areas respond to simple phoneme processing tasks. (Areas that respond to more complex language tasks, an anterior region, the IFG, displayed relative over-activation in people with dyslexia.)

Games involving nonsense words, rhyme, and sound manipulation will be enhanced by special auditory effects: Consonants are recorded louder while the adjacent vowel is lengthened and its sound softened. All games are carefully leveled by the complexity of the manipulations involved. (For results of clinical tests, see Ojemann 1989, Bertoncini et. al., 1989).

**3.1.1.4 Cross-modal Association**[**§**](http://www.w3.org/TR/coga-user-research/#cross-modal-association)

Main research from Leon (1996) and Shaymitz (1998). (See 8, 22, 24, 28, 30.)

The angular gyrus, a brain region considered pivotal in carrying out cross-modal (e.g., vision and language) associations necessary for reading, is involved. Current findings of under-activation in the angular gyrus of readers with dyslexia coincide with earlier studies of those who lost the ability to read due to brain damage centered in that same area of the brain.

The ability to link visual stimuli to auditory interpretation can be stimulated by multimedia implementation of the coming together of these separate disciplines. Activities are all carefully leveled to correlate a current ability level.

**3.1.1.5 Visual Recognition Skills**[**§**](http://www.w3.org/TR/coga-user-research/#visual-recognition-skills-1)

(Main school of research Livingstone (1993) and Martin and Lovegrove (1988).)(See 9, 15.) People with dyslexia have reduced synaptic activity in the V5 area.

V5 is part of the broader "magno-cellular -- large cell -- system" that processes fast-moving objects, and brightness contrasts. One interpretation is that a specific magno-cellular cell type develops abnormally in people with dyslexia (3).

For results of clinical tests see (1).

**3.1.1.6 Working Memory**[**§**](http://www.w3.org/TR/coga-user-research/#working-memory)

(Main school of research Beneventi et. al., 2008.)

Reduced activity in the pre-frontal and parietal cortex may result in working memory deficits. (40)

**3.1.2 Symptoms**

Common symptoms are:

* slow and laborious reading (If people are undiagnosed or diagnosed late, they may be illiterate or barely literate.);
* Concentration tends to fluctuate.

**Comment**: This is not a symptom for dyslexia. Rather a result of an environment not adapted to the dyslectic persons need. It is important to separate the diagnose from consequenses. Many persons with dyslexia work really hard and concentrated. Concnetration do not fluctuate more for a dyslectic person than for any person.

* poor and unusual spelling and grammar (Handwriting is unusable or very messy.);
* poor physical coordination; **Comment**: This is not a part of dyslexia. Older research suggested a connection but for example Kurt von Euler have shown it is not connected to dyslexia.
* difficulty remembering information (tends to fluctuate); **Comment**: Dyslectics in general do not have memory impairments. But since reading process is slow they are at risk of “running out of short term memory”. But the stuff that finds its way to the long term memory is not affected. It can be described as a slow information management process rather than problem with memory.
* difficulty with organizing and planning. **Comment**: No. This is not typical for a dyslectic person. It might maybe appear as a secondary effect if a dyslextic person I left without support. This is much more typical for other diagnoses.
* difficulty working within time limits; **Comment**: No. This is not typical for a dyslectic person. The reading and/or writing process can be slow but with the right tools this can be compensated. And it is only in this perspective it can be a problem. It is wrong describing this a general problem
* difficulty thinking and working in sequences, which can make planning difficult; **Comment**: Not more than any person. If this is a problem it is not connected to the diagnose. What seems to be true is that persons with dyslexia tends to be good at associating and “thinking outside the box”.
* visual processing difficulties, which can affect reading and recognizing places; **Comment:** It is true reading processes can be affected. It also seems that there is a difference in how dyslectics process pictures connected with text. But for recognizing places there are many dyslectics that are really good at that.
* poor auditory processing skills, which can make listening to oral instructions difficult, tiring and confusing.

**3.1.3 Challenges**

**Comment**: Many of the problems described in this section are better understood as secondary consequenses. It is important to understand the difference between what is in the diagnose and what might occur as a result of incorrect treatment and incoorect support. Basically problems with decoding, recognizing words and poor spelling is the core of the diagnose. Much of the other stuff is consequenses. It is also important to separate what is in the frontline of research and older and sometimes obsolete research. According to our opinion much of the information in 3.1.3 is incorrect.This section needs to be re-written.

**3.1.3.1 Memory**

* Poor short term memory for facts, events, times, dates, *symbols*.
* Poor working memory, i.e., difficulty holding on to several pieces of information at the same time. This is especially challenging while undertaking a task, e.g., taking notes while listening, addressing compound questions.
* Mistakes with routine information, e.g., providing age, phone number, or ages of children.
* Inability to hold on to information without referring to notes. **Comment**: Many dyslectic persons are really good at verbal information and can give long speeches without notes

**3.1.3.2 Automatizing Skills**[**§**](http://www.w3.org/TR/coga-user-research/#automatizing-skills)

People with dyslexia do not tend to automatize skills very well. A high degree of mental effort is required in carrying out tasks that typical individuals generally do not feel requires effort. This is particularly true when the skill is composed of several sub-skills (e.g., reading, writing, driving). **Comment**: if this is a problem it is probably another impairment that may occur alongside with the dyslexia and it can be dangerous to describe this as a general problem for all persons with dyslexia.

**3.1.3.3 Information Processing.**[**§**](http://www.w3.org/TR/coga-user-research/#information-processing.x)

* Difficulties with taking in information efficiently (could be written or auditory).
* Slow speed of information processing, such as a 'penny dropping' delay between hearing or reading something and understanding and responding to it.

**3.1.3.4 Communication Skills**[**§**](http://www.w3.org/TR/coga-user-research/#communication-skills)

* Lack of verbal fluency and lack of precision in speech (relevant for voice systems). **Comment**: On the opposite many persons with dyslexia develop great verbal skills
* Word-finding problems.
* Inability to work out what to say quickly enough. ???
* Misunderstandings or misinterpretations during oral exchanges. ???
* Sometimes, mispronunciations or a speech impediment may be evident. ???

**3.1.3.5 Literacy**[**§**](http://www.w3.org/TR/coga-user-research/#literacy)

* Difficulty in acquiring reading and writing skills. Reading is likely to be slow.
* If people are undiagnosed or diagnosed late, they may be illiterate or barely literate. **Comment**: It is maybe more correct to describe it as you might avoid reading, you become a non-reader but you are literate
* Where literacy has been mastered, problems continue, such as poor spelling; difficulty extracting meaning from written material; difficulty with unfamiliar words; and difficulty with scanning or skimming text.
* Particular difficulty with unfamiliar or new language, such as jargon.

**3.1.3.6 Organization, Sequencing**

* Difficulty organizing a sequence of events. No
* Incorrect sequencing of strings of numbers and letters (passwords, phone numbers).
* Chronic disorganization and misplacing/losing items. No
* Difficulty with time management and passage of time. No

**3.1.3.7 Navigation**

* Difficulty with finding the way to places or navigating - even in the context of a building. Often get lost. No

**3.1.3.8 Sensory Sensitivity**[**§**](http://www.w3.org/TR/coga-user-research/#sensory-sensitivity)

* Sensitivity to noise and visual stimuli. No
* Impaired ability to screen out background noise / movement. No
* Sensations of mental overload. No. Only connected to reading processes
* Tendency to "switch off".

**3.1.3.9 Lack of Awareness**[**§**](http://www.w3.org/TR/coga-user-research/#lack-of-awareness)

* Failure to notice body language. No
* Failure to realize consequences of their speech or actions. No

**3.1.3.10 Visual Stress**[**§**](http://www.w3.org/TR/coga-user-research/#visual-stress)

* Some people with dyslexic difficulties may experience visual stress when reading especially when dealing with large amounts of text. So, breaks are often needed.

**3.1.3.11 Coping Strategies**[**§**](http://www.w3.org/TR/coga-user-research/#coping-strategies)

It must be emphasized that individuals vary greatly in their learning difficulties. Key variables are the severity of the difficulties; the ability to identify and understand their difficulties; and successfully developing and implementing coping strategies. **Comment**: Persons with dyslexia do not have general learning difiiculties

By adulthood, many people with dyslexia are able to compensate through technology, reliance on others, and an array of self-help mechanisms, the operation of which requires sustained effort and energy. Unfortunately, these strategies are prone to break down under stressful conditions, which impinge on areas of weakness. **Comment**: Please read: <http://www.dailymail.co.uk/news/article-198603/Dyslexia-route-riches.html>

**3.1.3.12 Effects of Stress**[**§**](http://www.w3.org/TR/coga-user-research/#effects-of-stress)

People are particularly susceptible to stress (compared with the ordinary population) with the result that their impairments increase. No

**3.1.4 Scenarios and User Stories**[**§**](http://www.w3.org/TR/coga-user-research/#scenarios-and-user-stories)

**3.1.4.1 Scenario: Online Research**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-online-research)

A is a high school student with dyslexia. Although he can read, his level is slow and he finds it difficult. A has a school project and needs to do online research. A does not use a screen reader because he is afraid it will stop him from reading and improving his skills. **Comment**: I have worked in over 20 years in this area and never met a person giving that explanation. More likely A has not been introduced to assistive technology or can’t afford buying one.

A needs to be able to find content he needs easily. This includes finding the right resource and the right information inside that resource with minimal reading. He will then read the sections that he needs. He will do a web search, and a quick review of different pages to find the pages he needs.

**Comments**: People with dyslexia actually tend to read more than others. That is one of their problems. They can have difficulties skimming through a text. So to decide if he needs a certain page A probably read more before making that decision. And since the reading process is slow the main problem for A is to be able to finish the task on time. If the other students in the group spend 3 hours of reading A might spend 2, 3, 4 times as much. So the main challenges here are:

* Spelling search queries correctly
* Read to decide what material to include
* Read the included material
* Write the paper (if A has both reading and writing difficulties)

|  |  |
| --- | --- |
| Table of ICT Steps and challenges | |
| **Step** | **Challenge** |
| Search query |  |
| Scanning results |  |
| Doing a short review of different options and finding the most appropriate. |  |
| Finding the right content in the right document. |  |
| Reading the right content. |  |
| Collecting the information. |  |
| Copying for citing resources and collecting them with the right information. |  |
| Saving the work. |  |
| Putting it together and writing the paper. | Out of scope of this use case. |

**3.1.4.2 Scenario: Finding Out About a Change Event in an Email**

B is a mother with young children. She has dyslexia. B reads words, then stops to understand them. B is also a slow reader. B receives many emails. Important emails often are below or behind the scroll bar. Reading summaries of each email takes time. B has set her email app to tag emails from her child's school as important. However, B still needs to differentiate between emails from her child’s school that are crucial, and emails that are just informative. B needs to be able to find important content (such as school finishing at a different time next Monday) in a long school newsletter.

B’s email application changes, and she no longer knows how to tag senders as important. At the same time, her child starts at a new school. B has difficulty finding the information on how to tag emails from the new school as important. Also, the school starts sending many emails about projects her child is doing, and what is happening in class, so B does not have time to read each email as soon as it arrives. She postpones this task and important emails get lost.

**Comment**: This is actually a rather good description. Of a woman with adhd.

|  |  |
| --- | --- |
| Table of ICT Steps and challenges | |
| **Step** | **Challenge** |
| Finding out how to tag/label this from a sender as important (first time). |  |
| Remembering the process (re-finding it next time). |  |
| Tagging/labeling the new teacher. |  |
| Identifying important emails from the teacher, and distinguishing them from general interest-emails. |  |
| Finding important content in long emails. |  |

**3.1.4.3 Scenario: Using a Electronic Interface**

**Comment**: Problems described here has nothing to do with the person’s dyslexia. He has other problems

C is an adult living alone. He has dyslexia. C has impaired vision and auditory memory; and finds remembering sequences extremely challenging. C has a garden with an automatic watering system that has a one line (electronic) interface. The interface is not user friendly. C needs to select which sprinkler he is setting using an arrow key; then set the first time it should go on (using the arrow key in the number mode); then press enter; and then set the duration the sprinkler should run. He then needs to repeat the steps for the second time (or leave it blank). He then needs to repeat the process for the next sprinkler in the correct order. C has been shown how to use the system many times. However, each time the system needs to be adjusted, he makes mistakes and gets confused. Ten years later C still needs to call the gardener to change the settings, and is consonantly relearning the interface.

|  |  |
| --- | --- |
| Table of ICT Steps and challenges | |
| **Step** | **Challenge** |
| Learning the steps involved. | Learning the sequence. |
| Performing the steps correctly. | Remembering the sequence. Performing it in the correct order. |
| Undoing mistakes. | Remembering at which point he is in the sequence. Going back a step, and tracking the step he is at now. |

**3.1.4.4 Scenario: Using a Phone Menu**

**Comment**: This could be a description of an old person with declining capacity. But it has little to do with dyslexia. A better example should be that his father had some kind of medical equipment that suddenly doesn’t work. D has to try to read a manual that is only on paper. It takes too long to read and his father is at pain. If the manual was in an accessible pdf he could have read it fast with his tablet and text to speech software (TTS is the correct term for assistive tools for dyslectics. We have noticed that you use screen reader as a word but it better to say Text to speech software.

D is looking after his elderly father. D has dyslexia and impaired working memory; and impaired auditory discrimination. D can do one mental process at a time. D is weak at remembering numbers. He can remember one number at a time. D typically makes mistakes when dialing numbers. Often he will dial a number 3 or 4 times before he gets it right. D needs to speak to a doctor about his father who is sick. The doctor's office has a phone system with multi-layers. It takes D two attempts to dial the office. When faced with the menu system, D needs to listen to several similar options, understand the words, process the words, make a choice, identify the correct number, and enter the correct number into the keypad. Because he is trying to remember numbers whilst he is trying to listen to the next option, he misunderstands the options. He makes an incorrect choice. When trying to recover from the error he enters an invalid number and gets thrown off the line. D needs to redial this number but, as he is now upset, it takes him four attempts to dial it correctly. He is then faced with the same phone system. D makes more mistakes. After half an hour, he asks a neighbor to help him. D is very upset, which in turn upsets his sick father. D's self confidence at being able to look after his father is shattered.

|  |  |
| --- | --- |
| Table of ICT Steps and challenges | |
| **Step** | **Challenge** |
| Identifying the option he needs and remembering the right number associated with that option. | Auditory discrimination under pressure; memory of the correct number whilst listening and processing other options. |
| Entering the correct number. | Mapping the symbol to the number under pressure; eye-hand coordination. |
| Undoing mistakes. | Staying calm so his skills do not further deteriorate. |

**3.1.5 How They Use The Web and ICT**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict)

People with dyslexia tend to use mainstream technologies (e.g., a spell checker) to help them. They may use screen readers that highlight text as they read. They may use other assistive technology, such as Dragon or a Daisy reader, though they seem to be used more as teaching aids rather than typical Web access. Special software to help dyslexics includes Text Help.

**3.1.6 Characteristics of Content Optimized For This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group)

Content made for people with dyslexia tends to have:

* icons to visually reinforce structure and what each section is (such as examples, tips etc.);
* diagrams that illustrate the point of the content;
* short paragraphs, short sentences;
* a beginning-summary of the point. (This can also be true at the document or paragraph level, where the first sentence raises the main point of the paragraph.);
* well-structured text with headings (reducing reading of irrelevant text);
* use of bold on key terms (helps finding of relevant text);
* a "read it to me" button, that highlights text as it is read, and is simple to use;
* a clear, well-structured, minimalistic-navigation system, which is free from confusing steps and a complex user-interface flow.

In general, content for people with dyslexia helps users find the text they are looking for via visual aids, and reduces the need to read though irrelevant text to find the information that they are looking for.

**Comment**: The best help is to write clear and understandable text without irrelevant text. The most important content should be placed early in the text. A video as an alternative to the text give the person with dyslexia the opportunity to choose wether to read or watch.

**3.1.7 Specific Technologies**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies)

Assistive technologies include (incomplete list):

* Text help
* Dragon
* Kurzweil
* Ghotit
* Learning Ally
* Zoomreader
* Speak-it
* Read2Go

**3.1.8 Summary of Existing Research and Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines)

There are organizations that have produced guidelines for creating content for people with dyslexia, such as The British Dyslexia Association, and The Irish Dyslexia Association.

**3.1.8.1 Summary/Exerts of The British Dyslexia Association Guidelines and Dyslexia Style Guide**[**§**](http://www.w3.org/TR/coga-user-research/#summary-exerts-of-the-british-dyslexia-association-guidelines-and-dyslexia-style-guide)

This Guide is in three parts: 1. Dyslexia Friendly Text. 2. Accessible Formats. 3. Website design.

**3.1.8.1.1 Dyslexia-Friendly Text**[**§**](http://www.w3.org/TR/coga-user-research/#dyslexia-friendly-text)

The aim is to ensure that written material takes into account the visual stress experienced by some people with dyslexia, and to facilitate ease of reading. Adopting best practices for readers with dyslexia has the advantage of making documents easier on the eye for everyone.

**3.1.8.1.1.1 Media**[**§**](http://www.w3.org/TR/coga-user-research/#media)

* Use a plain, evenly-spaced, sans-serif font, such as Arial. See the BDA New Technologies Committee website: <http://bdatech.org/what-technology/typefaces-for-dyslexia/>
* Font size should be 12-14 point. Text should be expandable.
* Use dark-colored text on a light (not white) background. (Avoid pure white backgrounds because of glare.)

**Comment**: There is not enough research on this issue to say what the best is. Differences inbetween different persons is substantial.

**3.1.8.1.1.2 Headings and Emphasis**[**§**](http://www.w3.org/TR/coga-user-research/#headings-and-emphasis)

* For Headings, use a larger-font size in bold, lower case.
* Boxes and borders can be used for effective emphasis.
* Avoid underlining and italics. These tend to make the text appear to run together. Use bold instead.
* AVOID TEXT IN BLOCK CAPITALS. It is much harder to read.

**3.1.8.1.1.3 Layout** [**§**](http://www.w3.org/TR/coga-user-research/#layout)

* Use left-justified text with a ragged-right edge.
* Avoid narrow columns (as used in newspapers). Or in the tables in this document ☺
* Use lines of text that are not too long: 60 to 70 characters.
* Avoid cramping material and using long, dense paragraphs: space it out.
* Use text line spacing of 1.5.
* Avoid starting a sentence at the end of a line.
* Use bullet points and numbering rather than continuous prose.

**3.1.8.1.1.4 Writing Style**[**§**](http://www.w3.org/TR/coga-user-research/#writing-style)

* Use short, simple sentences in a direct style.
* Give instructions clearly.
* Avoid long sentences of explanation.
* Use active rather than passive voice.
* Avoid double negatives.
* Be concise.

**3.1.8.1.2 Increasing Accessibility**[**§**](http://www.w3.org/TR/coga-user-research/#increasing-accessibility)

* Flow charts are ideal for explaining procedures. ????
* Pictograms and graphics help locate information.
* Lists of do's and don't's are more useful than continuous text to highlight aspects of good practice.
* Avoid abbreviations if possible, or provide a glossary of abbreviations and jargon.
* For long documents, include a contents page at the beginning and an index at the end.

**3.1.8.1.3 Checking Readability**[**§**](http://www.w3.org/TR/coga-user-research/#checking-readability)

Note: The spell checker in MS Word can be set to automatically check readability. MS Word will then show the readability score every time spelling is checked.

* Check long documents in sections to determine which parts are too hard to read.
* Flesch Reading Ease score: Rates text on a 100-point scale. The higher the score, the easier it is to understand the document. For most standard documents, aim for a score of approximately 70 to 80.
* Flesch-Kincaid Grade Level score: Rates text on a U.S. grade-school level. For example, a score of 5.0 means that a fifth grader, i.e., a Year 6, average 10 years old, can understand the document. For most standard documents, aim for a score of approximately 5.0 by using short sentences, not by simplifying vocabulary.

**3.1.8.2 Accessible Formats**[**§**](http://www.w3.org/TR/coga-user-research/#accessible-formats)

Use an accessible format so content can be read by screen-reading software.

* Offer both the source MS Word files and derived PDF files where possible.
* Publicize availability of accessible formats.

**3.1.8.2.1 Preparing a Document for Text-Reading Software**[**§**](http://www.w3.org/TR/coga-user-research/#preparing-a-document-for-text-reading-software)

* Listening to a document using a text reader will take longer than visual reading.
* Place semi-colons, commas, or periods after bullet points and headings to make the screen-reader voice drop and pause. (A pale tint similar to the background color will make the punctuation less visually distracting.) Please do not recommend this. Screenreading devices for the blind will go crazy
* Use Styles in MS Word to organize headings and formatting. Use formats, otherwise conversion to for example pdf will be inacessible
* Use hyperlinks for Contents-Page listings.
* Number menu items. Why?
* Use internal and external hyperlinks for ease of navigation.
* Avoid capital letters in mid-line, as they may be read as single letters.
* Include as few signs and symbols as are absolutely necessary, e.g., asterisks or dashes (both short and long), as these will be spoken.
* Long dashes should be avoided. Use colons to make the voice pause.
* Use straight quotation marks. Curly or slanting ones may be read as ‘back quote’ by some screen readers.
* Avoid Roman Numerals and 'No.' for number.
* Consider whether abbreviations and acronyms need periods.
* Use hyphens in compound words to aid text-reading pronunciation.
* Chunk phone numbers to avoid being read as millions or hundreds of thousands. This will actually result in great problems for many users. Proper markup can help assistive devices to understand how to read phone numbers. So avoid to chunk them

**3.1.8.2.2 Website Design**[**§**](http://www.w3.org/TR/coga-user-research/#website-design)

Research shows that readers with dyslexia access text at a 25% slower rate on a computer. This should be taken into account when putting information on the web. When a website is completed, check the site and information for accessibility by carrying out these simple checks.

* Navigation should be easy. A site map is helpful. **Comment**: We do not think sitemaps are used by persons with dyslexia
* Use graphics, images, and pictures to break up text, while bearing in mind that graphics and tables may take a long time to download.
* Very-large graphics make pages harder to read.
* Offer alternate-download pages in a text-reader-friendly style. **Comment**: No! All pages should be text-reader friendly. This can easily be done by using proper markup and onformance with WCAG 2.0
* Where possible, design web pages that can be downloaded and read off-line. Why?
* Don't use moving text, which creates problems for people with visual difficulties. Text-reading software is unable to read moving text.
* In a table of contents, set hyperlinks so they show which pages have been accessed.
* Encourage the use of hyperlinks at the end of sentences.
* Make sure it is possible for users to set their own choices of font style and size and background and print colors.

**3.1.8.2.3 See Also**[**§**](http://www.w3.org/TR/coga-user-research/#see-also)

* [Distilled design of B.D.A. web](https://www.distilled.net/blog/distilled/usability-versus-dyslexia/)
* [BBC: My web, my way. Making the web easier to use](http://www.bbc.co.uk/accessibility/guides/allguides_index.shtml)

**3.1.8.3 Other Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#other-guidelines)

Tips found across the web include the following. [Dyslexia.com](http://www.dyslexia.com/library/webdesign.htm)

* Keep paragraphs short, and use a small amount of text on each page. **Comment**: This will make navigation and reading in phones really difficult
* If a long article is posted, create a topic index at the beginning so that a reader with dyslexia can quickly narrow in on the parts that interest him or her.
* Use default-font settings, or provide a way for users to choose their own styles.
* Use small icons to help with navigation between frequently-used web pages.
* Avoid using background images behind text. Make sure there is a good contrast between the color of the background and the color of the text.
* Do not set up background music to play, unless the site gives the user a choice whether to turn it on.

**3.1.9 Extent To Which Current Needs Are Met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met)

WCAG does help in that content can be used by a screen reader and headings should be used. Many of the most useful checkpoints are AAA, and hence not implemented, or are advisory techniques and hence, likewise, not adopted.

AA level conformance to WCAG does not significantly help reduce cognitive load or reduce dependency on text by formatting and pictorial aids. Other guidelines (non W3C such as British Dyslexia Association Guidelines) fill in some of the gaps in WCAG.

None of the reviewed guidelines help ICT interfaces of voice-mail systems. They also do not address getting additional help.

**3.1.10 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities)

Added to brainstorming section

**3.1.11 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence)

Dyslexia is a hidden disability thought to affect around 10% of the population, 4% severely.

Note that recent studies indicate dyslexia is particularly prevalent among small-business owners, with roughly 20 to 35 percent of US and British entrepreneurs being affected. This is important, as often people feel people with dyslexia are not in their user audience. With the exception of a scrabble game site, that is very unlikely. [39]

**3.1.12 Sources and References**[**§**](http://www.w3.org/TR/coga-user-research/#sources-and-references)

<http://www2.open.ac.uk/study/support/disability/orientation>

<http://www.bdadyslexia.org.uk/dyslexic/adult>

**3.1.12.1 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research)

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**3.2 Aphasia**[**§**](http://www.w3.org/TR/coga-user-research/#aphasia)

Communication difficulties may arise as the result of what is commonly known as a stroke. The type of impairment that results is known as Aphasia due to brain damage, which may cause receptive (comprehension) and expressive (speech and language) difficulties, dysarthria and dyspraxia where words can become unintelligible and a wide range of other difficulties that make articulation of accurate sounds difficult, and even vocalization impossible.

Aphasia can also impair an individual's ability to name items (finding the right word to refer to something), use correct grammar, cope with numerical calculations,and compose written language

**3.2.1 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-1)

*Memory*  
Receptive and Expressive Aphasia may result in impaired short term memory which can impact on re-learning language as can the impairment of auditory memory for relearning correct articulation and visual memory that affects reading and writing. Visuo-spatial Memory maybe an issue with the inability to remember how to get to places and recall locations, not helped if procedural memory is also involved where the order of doing things is affected. This is usually automatic but actions may have to be relearnt and there can be involvement of prospective memory that involves being aware of when certain activities have to be performed.

*Reasoning*  
Where intellectual capacity is affected there may be issues with reasoning, learning and thus remembering plus abstraction.

*Attention*  
Shortened attention span can occur with Aphasia.

*Language*  
Aphasia can cause difficulties with word finding, the meanings of words and sentences, grammar and comprehension affecting the ability to communicate.

*Speech Perception*  
Individuals may have difficulties coping with the sounds that make up speech being unable to interpret their meaning which affects understanding and speech output.

*Understanding Figurative Language*  
Idioms, metaphors, similes and other representations of language that contain abstract notions can cause issues for those with aphasia.

*Literacy*  
Aquired dyslexia can be an issue with individuals having to relearn how to read, sound out words and remember how to spell.

*Visual Perception*  
Not recognising letters and words impact on reading and even object recognition can be affected.

*Other Perception*  
Auditory perceptual difficulties affect the relearning of speech and recognition of sounds and words impacting on understanding.

*Knowledge*  
Aphasia does not necessarily impact on intelligence but knowledge will be trapped within the brain if the individual cannot express their thoughts.

*Behavioral*  
Behaviour can be affected by lability where there can be unnatural emotions including depression. Tiredness can impact on the ability to cope with day to day activities.

*Consciousness*  
Consciousness in those who have deep Aphasia with no communication can be difficult to assess.

**3.2.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-1)

*Aphasia*  
A disturbance of the comprehension and formulation of language caused by dysfunction in specific brain regions. The range of difficulties are very varied from total lack of the ability to communicate using speech and language to halting speech with misinterpretation of complex sentences. It can also include:

*Dysarthria*  
Loss of the motor ability that enables speech. Slurring, mispronunciation of words

*Aquired Dyspraxia*  
Motor speech disorder involving impairments in the motor control of speech production and an inability to copy correct articulation or plan how to say a word.

*Perseveration*  
Uncontrolled repetition of words or phrases

*Jargon*  
Inappropriate or incomprehensible words or phrases used without the individual realising they are not making sense.

**3.2.3 Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#challenges-1)

Aphasia can affect any aspect of language -- reading, writing, speaking or listening, or combinations of these abilities. However, difficulty in reading is probably the symptom that most impacts use of the web, because most websites do not make heavy demands on the other language-related skills. Minimal writing, such as form-filling, is common on websites, but extensive writing, such as a product review or blog comment, is usually optional. Speaking is rarely required for interacting with a conventional website. It may be used in websites that support real-time human-human communication, but then a human is present who can make an extra effort to understand someone who doesn't speak fluently. Speaking, however, is often required in telephone voice applications. Using the keypad as an alternative to voice may also be difficult for some people with aphasia due to motor problems which may be the result of a brain injury. Listening is required for websites where audio or video material is presented. Closed-captioning is not necessarily an option because many people with aphasia are unable to read. Many people with aphasia have some degree of hemiplegia, associated with the brain injury that affected their language. This means that using a mouse or keyboard can be difficult, so typing is not necessarily available as an alternative. In addition to difficulty reading text, some people with aphasia find certain websites confusing, for example, if there's too much material.

**3.2.4 Variability of Symptoms of Aphasia**[**§**](http://www.w3.org/TR/coga-user-research/#variability-of-symptoms-of-aphasia)

Another aspect of aphasia that impacts web accessibility is that the symptoms of aphasia vary considerably from person to person, and even in the same person from day to day. For example, some people with aphasia find that reading text for 15 or 20 minutes is ok, then the "brain shuts down". However, for some people reading is unaffected. Some people with aphasia can speak fairly well, but some don't talk at all. Specific aspects of reading might be differentially affected, for example, numbers, or people's names.

**3.2.5 Scenarios and User Stories**[**§**](http://www.w3.org/TR/coga-user-research/#scenarios-and-user-stories-1)

**3.2.5.1 Professional Man with Aphasia**[**§**](http://www.w3.org/TR/coga-user-research/#professional-man-with-aphasia)

Mr C was a highly skilled accountant before he suffered a stroke, he read widely and enjoyed using technology for both his work and leisure activities. After a severe left sided brain haemorrhage he not only could not speak clearly and had difficulty understanding conversation, but he also found that he could not read or write in a recognizable way. He found it hard to concentrate and when trying to use the Internet he did not have the skills to search for things of interest let alone read the content of the web pages. He was extremely frustrated, found himself breaking down. It was extremely distressing for his family. Slowly words returned and reading skills improved but he found the clutter on the screen exasperating and often failed to select the correct link or menu item. As he progressed in his rehabilitation, he was able to read slowly and made limited use of text to speech and increased font sizing. However, he tired easily, complained of eye strain and would often give up if he could not find something he was searching for. He could not cope with [CAPTCHA](http://www.captcha.net/) technology, found form filling difficult and would often buy the wrong items on Amazon by accident. However, with support and using simple technologies to de-clutter web sites, so that the text was clear without advertisements and excessive imagery Mr. C continued to take up the challenge of reading from the screen and his skills slowly improved. Eventually he was able to make use of social networks with friends who understood his difficulties and enjoyed asynchronous communication where he did not have to answer immediately and could take his time reading and composing messages.

**3.2.6 How They Use the Web and ICT**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict-1)

People with aphasia use the web to shop, get information, communicate with others, and be entertained. These tasks involve the language abilities affected by aphasia (listening, speaking, reading and writing), although to different extents. Tasks like shopping, getting information and being entertained typically heavily involve reading, with some writing required for form-filling. Communicating with others via email or social networking requires both reading and writing. People with aphasia who have difficulties with spoken language may find it hard to understand the audio tracks of videos. Speaking is very rarely required for interacting with a traditional website, so speaking difficulties are unlikely to impact web usage by people with aphasia. Telephone voice applications, on the other hand, are likely to be very difficult to use for people whose speech is affected.

**3.2.7 Characteristics of Content Optimized for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-1)

Impairments in reading ability affect many aspects of web usage. We can separate reading tasks into reading multiple paragraphs of informative text and reading captions on form items. Paragraphs of informative text can be made easier to read through general techniques that improve readability, such as simpler language, well-structured layout and organization, use of white space, and typography that enhances legibility. Form filling also requires reading, but in a different way. The purpose of reading the caption on a form is to understand what the user has to do to provide the correct information for the form. Form captions need to be simple and clear. The user should be able to hear as well as see the caption on a form as needed, even repeating the audio several times if necessary. Well-designed icons can also supplement text and audio captions. The user should also be able to hear their own input, since some people with aphasia can write but not read. Optional and required form fields should be clearly distinguished.

* Important points are short with no ambiguity and may need to be highlighted with images and boxed.
* Each point is made in a clear order so it tells a story.
* Sentences are in first person where possible and use easy to understand words.
* Numbers are kept in numerical format unless large and unwieldy when they also need to be in written form.
* Increased amounts of white space and 14 point or larger sans serif fonts are used.
* Bold type for headings and keywords
* Colour can be used to link items
* Pictures are of good quality and clearly represent what is being discussed.
* Keep to one style for all items with clear logical navigation

Below is the direct quote from Tanya A. Rose, Linda E. Worrall, Louise M. Hickson, Tammy C. Hoffmann, (2012) Guiding principles for printed education materials: Design preferences of people with aphasia. International Journal of Speech-Language Pathology 14:1, pages 11-23.

* Numbers: Present smaller numbers as ﬁgures.
* Present larger numbers (e.g., 40,000) in both ﬁgures and words.
* Present fractions in words.
* People with aphasia may have a clear preference regarding which representation (i.e., ﬁgures or words) they consider easier to read, and should be provided with the option to choose, where possible.
* Font size and typeface: Use a minimum 14-point font.
* Use a san serif font (e.g., Verdana or Arial).
* Use a font that is clear and bold.
* Line spacing and blank space: Use 1.5 or double line spacing for paragraphs.
* Ensure blank space is included around sections of text.
* Document length: People with aphasia may want several pages of information if it is presented in a simpliﬁed format.
* Preferences for document length may not be related to the recipient ’ s reading ability or aphasia severity, and the recipient ’ s preference for amount of information should be ascertained.
* Graphics: Include graphics, preferably photographs.
* Check preferences for the inclusion of graphics and preferences for graphic type, particularly when developing written information for people with more severe reading difﬁculties.
* Ensure all graphics relate to the text and are labelled.

**3.2.7.1 More References**[**§**](http://www.w3.org/TR/coga-user-research/#more-references)

Kitching, J. (1990). Patient information leaﬂ ets: The state of the art. Journal of the Royal Society of Medicine , 83 , 298 – 300. Tarleton, B.,(‎2008) Finding the Right Help - University of Bristol <http://www.bristol.ac.uk/wtwpn/resources/finding-the-right-help-report.pdf> (accessed 27th June 2014)

**3.2.8 Specific Technologies**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies-1)

Specific technologies that can help those who have communication difficulties vary enormously. They range from simple text to speech that can aid reading ability, the highlighting of text as items are read aloud, enlarged font sizing and different font styles to complex communication aids.

Those who have Aphasia may find it helpful to use the reading aids mentioned above and those who cannot communicate with text may need to use symbols or pictograms or other forms of augmentative and alternative communication (AAC). (See non-verbal section)

**3.2.9 Extent To Which Current Needs Are Met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-1)

It entirely depends on the degree to which an individual is able to use language both written and spoken, expressive and receptive but it is clear that those who have considerable communication disorders with minimal literacy skills will have difficulty accessing web pages and coping with navigation within and between sites. To this extent there are considerable gaps that need to be bridged including:

* lack of clear navigational elements - guidance should not just be about screen reader and keyboard access but also about usability
* clutter around main content - guidance needs to ensure increased use of white space where it can be used to highlight key points
* poor headings, paragraph structures - guidance needs to highlight how use of markers for these elements such as icons, bold text and consistent spacing can help understanding
* poor summarising of content - guidance to authors to ensure they provide overview of content in clear fashion
* use of colour to aid comprehension - guidance to ensure sites maintain a consistent style if this method for key points is used.
* addition of media elements - guidance to access players and use of captions with summaries can help all users.

**3.2.10 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-1)

"People with aphasia comprehended significantly more aphasia-friendly paragraphs than control paragraphs. They also comprehended significantly more paragraphs with each of the following single adaptations: simplified vocabulary and syntax, large print, and increased white space. Although people with aphasia tended to comprehend more paragraphs with pictures added than control paragraphs, this difference was not significant. No significant correlation between aphasia severity and the effect of aphasia-friendly formatting was found. " <http://www.tandfonline.com/doi/abs/10.1080/02687030444000958>

Research has shown that Speech Therapists are not necessarily the best judge of whether a website is good or bad in terms of clarity, layout etc for someone who has Aphasia. (Carlye Ghidella, Stephen Murray, Melanie Smart, Kryss McKenna & Linda Worrall, (2005) Aphasia websites: An examination of their quality and communicative accessibility. Aphasiology 19:12, pages 1134-1146.)

**3.2.11 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-1)

Anyone can acquire aphasia (a loss of the ability to use or understand language), but most people who have aphasia are in their middle to late years. Men and women are equally affected. It is estimated that approximately 80,000 individuals acquire aphasia each year. About 1 million persons in the U.S. currently have aphasia. Although estimating the prevalence of aphasia is difficult, especially in the developing world, aphasia is estimated to affect about 0.4 percent of the population. "This year 130,000 people in the UK will have a stroke. One-third of those who survive will have aphasia. Surprisingly, there are currently about 250,000 people with aphasia in the UK alone." - from <http://www.ukconnect.org/aphasiaquestionsandanswers_302.aspx>

**3.2.12 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research-1)

Brennan, A., Worrall, L., & McKenna, K. (2005). The relationship between specific features of aphasia-friendly written material and comprehension of written material for people with aphasia: An exploratory study. Aphasiology, 19(8), 693-711. doi:10.1080/02687030444000958

Herbert R., Haw, C., Brown, C., Gregory E. and Brumfitt, S. (2012). Accessible Information Guidelines. London: Stroke Association. Retrieved from [http://www.stroke.org.uk](http://www.stroke.org.uk/)

Caitlin Brandenburg, Linda Worrall, Amy D. Rodriguez & David Copland, (2013) Mobile computing technology and aphasia: An integrated review of accessibility and potential uses. Aphasiology 27:4, pages 444-461.

Tanya A. Rose, Linda E. Worrall, Louise M. Hickson & Tammy C. Hoffmann, (2011) Exploring the use of graphics in written health information for people with aphasia. Aphasiology 25:12, pages 1579-1599.

Aimee Dietz, Karen Hux, Miechelle L. McKelvey, David R. Beukelman & Kristy Weissling, (2009) Reading comprehension by people with chronic aphasia: A comparison of three levels of visuographic contextual support. Aphasiology 23:7-8, pages 1053-1064.

Tanya A. Rose, Linda E. Worrall, Louise M. Hickson, Tammy C. Hoffmann, (2012) Guiding principles for printed education materials: Design preferences of people with aphasia. International Journal of Speech-Language Pathology 14:1, pages 11-23.

Rose, T. A., Worrall, L. E., Hickson, L. M., & Hoffmann, T. C. (2012). Guiding principles for printed education materials: Design preferences of people with aphasia. International Journal of Speech-Language Pathology, 14(1), 11-23. doi:10.3109/17549507.2011.631583

**3.2.13 Glossary**[**§**](http://www.w3.org/TR/coga-user-research/#glossary)

**3.2.13.1 Communication Disorders**[**§**](http://www.w3.org/TR/coga-user-research/#communication-disorders)

The American Association of Speech-Language-Hearing Association (ASHA) definition for communication disorders is as follows: "A communication disorder is an impairment in the ability to receive, send, process, and comprehend concepts or verbal, nonverbal and graphic symbol systems. A communication disorder may be evident in the processes of hearing, language, and/or speech. A communication disorder may range in severity from mild to profound. It may be developmental or acquired. Individuals may demonstrate one or any combination of communication disorders. A communication disorder may result in a primary disability or it may be secondary to other disabilities. - See more at: <http://www.asha.org/policy/RP1993-00208/>"

**3.2.13.2 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-2)

Cognitive function as "an intellectual process by which one becomes aware of, perceives, or comprehends ideas" ([Mosby, 2009](http://medical-dictionary.thefreedictionary.com/Cognitive+Function))may or may not be tied directly to a communication disorder. An individual may have high cognitive functioning and still be unable to communicate.

**3.3 Non-verbal - Severe Speech and Language impairments**[**§**](http://www.w3.org/TR/coga-user-research/#non-verbal---severe-speech-and-language-impairments)

Communication Difficulties and Disorders may include non-verbal individuals such as those who have Aphonia with no vocal output, Anarthria where speech musculature is involved and other disabilities that preclude any form of speech and language. The description may also include those with Aphasia who may have receptive and expressive difficulties (see section - Aphasia), Dysarthria and dyspraxia where words may become unintelligible and a wide range of other difficulties that make articulation of accurate sounds difficult, language expression and understanding hard to achieve and vocalization impossible. This can include those who have hearing impairments and cognitive disabilities but in this section the concentration is on those who use Augmentative and Alternative Communication (AAC).

"Augmentative and alternative communication (AAC) includes all forms of communication (other than oral speech) that are used to express thoughts, needs, wants, and ideas. We all use AAC when we make facial expressions or gestures, use symbols or pictures, or write." [American Speech-Language-Hearing Association](http://www.asha.org/public/speech/disorders/AAC/)

**3.3.1 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-3)

These may be impaired and affect the choice of symbols and devices used to support communication needs. The impact of severe cognitive impairment affects all aspects of speech and language with possible reduced expressive and receptive abilities. There may be difficulties in the composition of words, phrases and sentences and also the understanding of them whether represented by symbols, gestures or other methods of communication.

*Memory*  
Cognitive impairments may result in impaired short term memory which can impact on learning how to use any symbolic representations of speech such as pictograms and other photographic symbols. This may result in a very reduced number of symbols being used on a daily basis. Lack of Auditory memory affects the ability to gain skills in phonemic awareness that aids literacy skills. Difficulties with visuo-spatial memory impact on the speed withwhich symbols may be found on a communication board or located on a screen and with physical difficulties this can further slow communication. Procedural memory difficulties result in poor automaticity in terms of Language Acquisition through Motor Planning (LAMP) which is one of the ways individuals can speed their AAC output.

*Reasoning*  
Where intellectual capacity is affected there may be issues with reasoning, learning and thus remembering plus abstraction.

*Attention*  
Shortened attention span can occur alongside distractability when other cognitive impairments are present.

*Language*  
Young AAC users may have difficulty developing good sentence construction for written language in particular if reading skills are poor

*Speech Perception*  
Cognitive impairments can affect speech perception

*Understanding Figurative Language*  
Idioms, metaphors, similes and other representations of language that contain abstract notions can cause issues for AAC users

*Literacy*  
Aquired dyslexia can be an issue with individuals having to relearn how to read, sound out words and remember how to spell.

*Visual Perception*  
Not recognising letters and words impact on reading and even object recognition can be affected

*Other Perception*  
Auditory perceptual difficulties can affect phonemic awareness and any possible speech output

*Knowledge*  
An AAC user does not necessarily have intellectual difficulties but knowledge can be trapped within the brain if the individual cannot express their thoughts.

*Behavioral*  
Behaviour can be affected by the inability to communicate with considerable frustration occurring at times. Individuals may also become depressed and irritable, however these individuals can also show amazing resilience and understanding when issues arise.

*Consciousness*  
Consciousness in those who have no communication skillscan be difficult to assess

**3.3.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-2)

*Anarthria*: Loss of the motor ability that enables speech. Complete loss of the ability to vocalize words as a result of an injury to the part of the brain that is responsible for controlling the larynx.

*Aphasia*: A disturbance of the comprehension and formulation of language caused by dysfunction in specific brain regions. There may be an inability to read, naming problems (finding the right word to refer to something), mis-articulated words, grammatical errors in speech, difficulty with numerical calculations, slow and effortful speech, inability to compose written language or inability to understand speech.

*Apraxia*: An acquired oral motor speech disorder affecting an individual's ability to translate conscious speech plans into motor plans.

*Autism*: A disorder of neural development characterized by impaired social interaction and verbal and non-vocal communication.

*Aphonia*: The inability to produce voice.

*Alalia*: A delay in the development or use of the mechanisms that produce speech.

*Dyslalia*: Difficulties in talking due to structural defects in speech organs.

*Developmental verbal dyspraxia*: Motor speech disorder involving impairments in the motor control of speech production.

*Developmental Disabilties*: Fragile X, Down syndrome, pervasive developmental disorders, fetal alcohol spectrum disorders, cerebral palsy.

*Intellectual Impairment*: traumatic brain injury, lead poisoning, Alzheimer's disease.

**3.3.3 Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#challenges-2)

The following rights are summarized from the United States of America's Communication Bill of Rights put forth in 1992 by the US National Joint Committee for the Communication Needs of Persons with Severe Disabilities. (1992). Guidelines for meeting the communication needs of persons with severe disabilities. Asha, 34(Suppl. 7), 2–3. <http://www.asha.org/NJC/bill_of_rights.htm>

"All people with a disability of any extent or severity have a basic right to affect, through communication, the conditions of their existence. All people have the following specific communication rights in their daily interactions.

Each person has the right to

* request desired objects, actions, events and people
* refuse undesired objects, actions, or events
* express personal preferences and feelings
* be offered choices and alternatives
* reject offered choices
* request and receive another person's attention and interaction
* ask for and receive information about changes in routine and environment
* receive intervention to improve communication skills
* receive a response to any communication, whether or not the responder can fulfill the request
* have access to AAC (augmentative and alternative communication) and other AT (assistive technology) services and devices at all times
* have AAC and other AT devices that function properly at all times
* be in environments that promote one's communication as a full partner with other people, including peers
* be spoken to with respect and courtesy
* be spoken to directly and not be spoken for or talked about in the third person while present
* have clear, meaningful and culturally and linguistically appropriate communications"

**3.3.3.1 How Symptoms result in Challenges for Young People who are Non-Verbal**[**§**](http://www.w3.org/TR/coga-user-research/#how-symptoms-result-in-challenges-for-young-people-who-are-non-verbal)

Young non-vocal communicators are very often encouraged to make vocal speech and all efforts are made to achieve that goal. There is a persistent idea that if AAC systems are introduced early in a child’s life it will delay or prevent the development of verbal speech. This conclusion is erroneous. Research (<http://www.pecsusa.com/research.php>) has shown that the introduction of AAC early in a child’s life will actually help the child develop verbal speech if that capability exists. The emphasis on making verbal speech still continues after AAC is introduced, but the fact that the child now has a means of communicating means that their right to communicate is already being supported. In situations where Speech and Language Pathologists (SLP) attempt to introduce AAC early the challenge to enlist the family/caregivers as supporters of AAC often fails. In situations where no SLP is available and/or the knowledge that there are relatively inexpensive interventions available and/or the parents/caregivers do not support the system, the child is not supported with an AAC system and expectations fall far short of the child's potential.

Major Challenges:

**3.3.3.1.1 No Support**[**§**](http://www.w3.org/TR/coga-user-research/#no-support)

Because very special conditions must be present to support a non-vocal communicator with AAC (resources, knowledge, support) non-vocal people are often not helped to develop even low-tech communication systems. This leads to vastly reduced opportunities for the non-vocal communicator. In individuals for whom functional level prohibits using AAC tools, there are other strategies such as indirect selection, facial expression, vocalizations, gestures, and sign languages.

**3.3.3.1.2 Non-Interoperability**[**§**](http://www.w3.org/TR/coga-user-research/#non-interoperability)

Since high-tech AAC systems almost always have different operating systems and file structures, each time a new device is added someone has to manually re-program the communication system. This non-interoperability problem exists across almost all devices, even extending to multiple devices developed within by a single manufacturer. This is a major challenge facing most non-vocal people using high-tech AAC systems.

**3.3.3.1.3 Costs of Low-Tech AAC**[**§**](http://www.w3.org/TR/coga-user-research/#costs-of-low-tech-aac)

Communication books, symbol sets and software to customize and print icons, activity boards, picture schedules, and other low-tech communication tools are relatively inexpensive as is training for non-vocal people, SLPs, and parents/caregivers. Inexpensive is a relative term, and many communities do not have resources for even the basic tools, but if a basic methodology is employed, then even makeshift tools will enable some communication beyond making sounds, pointing, and gesturing.

**3.3.3.1.4 Costs of High-Tech AAC**[**§**](http://www.w3.org/TR/coga-user-research/#costs-of-high-tech-aac)

High-tech AAC systems are expensive as are extended warranties. The life of a device is usually limited to the life of the extended warranty offered by the manufacturer. This is due not only to the expense involved in supporting an out-of-warranty device but also to the fact that parts become scarce when devices are discontinued and manufacturing stops. Medicare standards (in the US?) prohibit the purchase of a new device until five years from the purchase date of the previous device so insurance companies and institutions follow that pattern. This makes the de-facto life of high-tech AAC devices five years, and this is echoed by manufacturer warranties which typically extend coverage to five years.

**3.3.3.1.5 Costs of Lack of AAC**[**§**](http://www.w3.org/TR/coga-user-research/#costs-of-lack-of-aac)

There are costs associated with failing to implement AAC. These costs include social and health consequences for neuro-typical as well as other communicators. AAC introduces a range of behavior modification techniques for non-neuro-typical individuals. Example: use of a picture schedule creates the opportunity for frictionless transitions in individuals for whom transitions are difficult and who may act out their fears with self-harming or other behaviors.

**3.3.4 Scenarios and User Stories**[**§**](http://www.w3.org/TR/coga-user-research/#scenarios-and-user-stories-2)

**3.3.4.1 Young Non-Verbal Woman**[**§**](http://www.w3.org/TR/coga-user-research/#young-non-verbal-woman)

S is a 21 year old woman with a chromosomal deletion known as Cri-du-chat Syndrome, or Five P Minus (5p-). She is a mosaic; she has the transcription error in approximately 50 percent of her cells, so some of the classic Cri-du-chat symptoms are not present such as congenital heart problems and microcephaly. S has orthopedic impairments, is ataxic (loss of full control of bodily movements) and hypotonic (abnormally low body tone) and she is developmentally disabled. She is also nearly completely non-vocal, but she has a communication system. S uses the Picture Exchange Communication System (PECS) (<http://www.pecsusa.com/pecs.php>) as her base methodology and this is invoked in whatever communication book, picture schedule, choice boards, and other low-tech systems she uses. PECS methodology is also used in her high-tech voice output devices. Using PECS as the base methodology supports her with a consistent approach that has allowed her to develop into a very confident communicator. Since she cannot read or write she relies on icons and pictures to navigate and make her communication choices. She has been using a communication book since she was five years old (and still does) and she started using high-tech AAC systems when she was ten years old. All of her high-tech AAC devices have been purchased from a single vendor, and none of them have been interoperable, requiring her communication environment to be created manually at each change of device. None of her other non-vocal classmates/peers have communication systems.

**3.3.5 How They Use the Web and ICT**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict-2)

There are many people who have spoken language communication difficulties who can cope with the use of the web and ICT at a very high level. It can provide their only method for dialogue using e-mail, instant messaging, social media etc. Individuals with cognitive disabilities as well as communication difficulties may on the other hand struggle with elements of Internet usage. They may find the intricacies of navigation, complex content and confusing messaging systems hard to access.

There remains a lack of suitable systems that are simple enough for symbol users to engage with a wide range of social networks, email and voice systems. Users generally need to use bespoke software that allows for symbol to text and text to symbol conversions. Use of the web is hampered by a lack of symbol based informational sites - simple word to symbol translation does not always solve comprehension problems.

**3.3.6 Characteristics of Content Optimized for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-2)

Those who have developmental speech and language disorders and make use of AAC may have difficulties learning to read or may not have the cognitive capacity to learn to read and so there are considerable challenges producing web content and technologies that can support this user group. However, there are also huge benefits for these individuals if they can access the web in terms of interactive communication and socialisation. Features that can help include

* Bold type for headings and keywords
* Introduce high levels of white space, short paragraphs, larger than usual sans serif fonts and increased line spacing.
* Offer increased sizes for menu buttons and media controls.
* Clear and unambiguous use of images with good contrast levels.
* Simple alternative tags and text explanations for media items.
* Clear short sentence structure with use of concrete concepts for easy reading.
* Use of first person whilst also avoiding conditional tenses.
* Offer speech output for all main content - text to speech or recorded speech files embedded on the website.
* Use colour to delineate areas with logical keyboard accessible navigation
* Static content for the main areas of a website with meaningful use of dynamic content if necessary.
* Increased levels of complexity related to content should be available on secondary pages for those who have higher level literacy skills.

**3.3.7 Specific Technologies**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies-2)

Specific technologies that can help those who have communication difficulties vary enormously. They range from simple text to speech that can aid reading ability, the highlighting of text as items are read aloud, enlarged font sizing and different font styles to complex communication aids.

There are a wide range of systems including unaided AAC systems that do not require an technologies but may include facial expression, vocalizations, gestures, and sign languages. Then there are the low-tech communication aids which may be defined as those that do not need batteries, electricity or electronics such as communication books and boards. High-tech communication systems can include speech generating devices and software for computers, tablets, and smart phones.

Specific groups of AAC users will use different types of symbols and devices. They include those with: cerebral palsy, intellectual impairment, autism, developmental verbal dyspraxia, traumatic brain injury (TBI), aphasia, locked-in syndrome, amyotrophic lateral sclerosis, Parkinson's disease, multiple sclerosis, dementia.

Types of symbol AAC methodologies:

* Picture Exchange Communication System (PECS),
* MinSpeak etc
* LAMP

Symbol sets:

* Bliss symbols
* Symbol Stix
* PCS
* Widgit
* ARASAAC
* Sclera

**3.3.8 Extent To Which Current Needs Are Met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-2)

Those who use AAC devices often depend on symbols for communication and may have poor literacy skills or if they do have good literacy skills they may struggle to fill in forms and online documentation due to other physical disabilities. It is essential that there is an understanding of the slowness of interaction that might take place with challenging touch screen, keyboard or switch access. At present very few websites offer:

* Integrated speech output to support textual content
* Total keyboard accessibility that can be translated to switch access
* Alternative navigational elements that are clear and large enough for touch screen use
* Chances to adapt the look and feel of pages to suit user needs - font sizing, colour backgrounds, decluttering to aid readability
* Use of colour to aid comprehension and highlight key points.
* Images and icons that can explain content

**3.3.9 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-2)

It is possible to link to symbol databases to offer options for symbols to appear that can explain the meaning of words. This system is used by [Widgit Online Point](http://widgit.com/products/point/index.htm) There is the problem of words having more than one meaning and several symbols being presented as the system cannot cope with the context of word in a sentence but this will happen in time.

Browsers and Websites can offer toolbars that allow text to be read aloud with text highlighting, font changing, CSS adaptations and links to services such as [Readability](https://readability.com/)

**3.3.10 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-2)

Between 6 and 8 million people in the U.S. have some form of language impairment. Research suggests that the first 6 months of life are the most crucial to a child's development of language skills. For a person to become fully competent in any language, exposure must begin as early as possible, preferably before school age.

Approximately 7.5 million people in the United States have trouble using their voices. Spasmodic dysphonia, a voice disorder caused by involuntary movements of one or more muscles of the larynx (voice box), can affect anyone. The first signs of this disorder are found most often in individuals between 30 and 50 years of age. More women than men appear to be affected. Laryngeal papillomatosis is a rare disease consisting of tumors that grow inside the larynx, vocal folds, or the air passages leading from the nose into the lungs. It is caused by the human papilloma virus (HPV). Between 60 and 80 percent of laryngeal papillomatosis cases occur in children, usually before the age of three. Speech Source: Compiled by NIDCD based on scientific publications.

The prevalence of speech sound disorders in young children is 8 to 9 percent. By the first grade, roughly 5 percent of children have noticeable speech disorders; the majority of these speech disorders have no known cause. By the time they are six months old, infants usually babble or produce repetitive syllables such as "ba, ba, ba" or "da, da, da." Babbling soon turns into a kind of nonsense speech jargon that often has the tone and cadence of human speech, but does not contain real words. By the end of their first year, most children have mastered the ability to say a few simple words. By 18 months of age, most children can say 8 to 10 words. By age 2, most put words together in crude sentences such as "more milk." At ages 3, 4, and 5, a child's vocabulary rapidly increases, and he or she begins to master the rules of language. It is estimated that more than 3 million Americans stutter. Stuttering can affect individuals of all ages, but occurs most frequently in young children between the ages of 2 and 6. Boys are 3 times more likely than girls to stutter. Most children, however, outgrow their stuttering, and it is estimated that fewer than 1 percent of adults stutter. [Compiled by NIDCD based on scientific publications.](http://www.nidcd.nih.gov/health/statistics/vsl/Pages/stats.aspx)

**3.3.11 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research-2)

W3C (2014) Research Report on Easy to Read on the Web Editors' Draft 23 January 2014 http://www.w3.org/WAI/RD/2012/easy-to-read/note/ED-E2R-20140123

Clarke M, Lysley A, Nicolle C and Poulson D (2002) World Wide AAC: Developing Internet Services for People using AAC. In: Proceedings of ISAAC 2002 10th Biennial Conference of the International Society for Augmentative and Alternative Communication, 10-15 August 2002, Odense, Denmark

Communication Matters (2013) Shining a light on Augmentative and Alternative Communication http://www.communicationmatters.org.uk/shining-a-light-on-aac

Pistorius,M. (2011) 'Communication: An AAC User's Perspective', Communication Matters Conference 2011

United Nations Expert Meeting on Building Inclusive Societies and Development through Promotion of Accessible Information and Communication Technologies (ICTs); Emerging issues and trends Tokyo, Japan, 2012, http://www.un.org/disabilities/

The Bercow Report: A Review of Services for Children and Young People 0 to 19 with Speech, Language and Communication Needs, 2008 http://dera.ioe.ac.uk/8405/1/7771-dcsf-bercow.pdf

**3.3.12 Glossary**[**§**](http://www.w3.org/TR/coga-user-research/#glossary-1)

**3.3.12.1 Communication Disorders**[**§**](http://www.w3.org/TR/coga-user-research/#communication-disorders-1)

The American Association of Speech-Language-Hearing Association (ASHA) definition for communication disorders is as follows: "A communication disorder is an impairment in the ability to receive, send, process, and comprehend concepts or verbal, nonverbal and graphic symbol systems. A communication disorder may be evident in the processes of hearing, language, and/or speech. A communication disorder may range in severity from mild to profound. It may be developmental or acquired. Individuals may demonstrate one or any combination of communication disorders. A communication disorder may result in a primary disability or it may be secondary to other disabilities. - See more at: <http://www.asha.org/policy/RP1993-00208/>"

**3.3.12.2 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-4)

Cognitive function as "an intellectual process by which one becomes aware of, perceives, or comprehends ideas" ([Mosby, 2009](http://medical-dictionary.thefreedictionary.com/Cognitive+Function))may or may not be tied directly to a communication disorder. An individual may have high cognitive functioning and still be unable to communicate.

**3.4 Aging and Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#aging-and-dementia)

The Aging and Dementia Gap Analysis focuses on issues and techniques for improving inclusion and quality of life for people with dementia using ICT. Our strategy includes a key ambition to develop ICT techniques that will work better for people affected by dementia; and to define, develop and improve dementia and aging-friendly ICT.

Many people are able to age in good health and remain active participants in society throughout their lives. Others experience physical and cognitive limitations, and may lose the ability to live independently. Although dementia mainly affects older people, it is not a normal part of aging.

The most elder-rich period of human history is upon us. How we regard and make use of this windfall of elders will define the world in which we live.

There is a good phrase to remember regarding people with dementia: "If you've met one person with dementia, you've met one person with dementia". This has been largely attributed to the late Tom Kitwood, although no direct source has been found.

**3.4.1 Description of Aging and Cognitive Decline**[**§**](http://www.w3.org/TR/coga-user-research/#description-of-aging-and-cognitive-decline)

From Miriam Webster's Dictionary, the definition of aging is: Gradual change in an organism that leads to increased risk of weakness, disease, and death. It takes place in a cell, an organ, or the total organism over the entire adult-life span of any living thing. There is a decline in biological functions and inability to adapt to metabolic stress. Changes in organs include the replacement of functional cardiovascular cells with fibrous tissue. Overall effects of aging include reduced immunity; loss of muscle strength; decline in memory and other aspects of cognition; and loss of hair color and elasticity in the skin. In women, the process accelerates after menopause.

Aging definition: an age-dependent or age-progressive decline in intrinsic physiological function, leading to an increase in age-specific mortality rate (i.e., a decrease in survival rate), and a decrease in age-specific reproductive rate. (7) To sum it up, aging is a complex process composed of several features: 1) an exponential increase in mortality with age; 2) physiological changes that typically lead to a functional decline with age; and 3) increased susceptibility to certain diseases with age. So, the aging process can be defined as a progressive deterioration of physiological function, an intrinsic age-related process of loss of viability, and an increase in vulnerability. (8)

**3.4.2 Description of Dementia and Cognitive Decline**[**§**](http://www.w3.org/TR/coga-user-research/#description-of-dementia-and-cognitive-decline)

Dementia is defined as a severe loss of cognitive abilities that disrupts daily life. Symptoms include memory loss; mood changes; visual perception; focus challenges; and problems with communicating, decision making, and reasoning. Dementia is not a normal part of growing old. It is caused by diseases of the brain, the most common being Alzheimer's. Dementia is progressive, which means the symptoms will gradually get worse.

**3.4.2.1 Description of Alzheimer's**[**§**](http://www.w3.org/TR/coga-user-research/#description-of-alzheimer-s)

Alzheimer's disease (62% of those with dementia): A physical disease caused by changes in the structure of the brain and a shortage of important chemicals that help with the transmission of messages. In short, Alzheimer's is a brain disease that causes a slow decline in memory, thinking and reasoning skills.

Statistics are from 2013 UK Study. Need to map with WHO and others.

**3.4.2.2 Description of Less Common (Non-Alzheimer's)[§](http://www.w3.org/TR/coga-user-research/" \l "description-of-less-common-non-alzheimer-s" \o "Permalink for description-of-less-common-non-alzheimer-s)**

Set of non-Alzheimer's Dementia diseases:

* Vascular Dementia (17%): Caused by problems in the supply of blood to the brain, commonly caused by a stroke or a series of small strokes.
* Mixed Dementia (10%): A type of dementia where a person has a diagnosis of both Alzheimer's disease and vascular dementia.
* Dementia with Lewy bodies (4%): One of the less-common forms of dementia, it is caused by irregularities in brain cells, leading to symptoms similar to Alzheimer's disease, and Parkinson's disease.
* Rarer causes of Dementia (3%): There are many rarer causes of diseases and syndromes that can lead to dementia or dementia-like symptoms, including Corticobasal degeneration and Creutzfeldt-Jakob disease.
* Fronto-temporal Dementia (2%): Rare when all ages are taken into account, but relatively common in people under 65, it is a physical disease that affects the brain.

Statistics are from 2013 UK Study. Need to map with WHO and others.

**3.4.3 Cognitive Function**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-function)

This section is a technical reference. Jump to the next section on Symptoms for more practical information.

**3.4.3.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. Understanding the role of age and fluid intelligence in information search, ASSETS '12 Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility, 119-126, S. Trewin, J.T. Richards, V.L. Hanson, D. Sloan, B.E. John, C. Swart, J.C. Thomas, 2012. (Contributed by Katherine Deibel)

**3.4.3.2 Cognitive-Function Decline Due to Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-function-decline-due-to-dementia)

**Overview**: The parts of the brain and cognitive functions affected depend upon the type of dementia.

**3.4.3.2.1 Alzheimer's**[**§**](http://www.w3.org/TR/coga-user-research/#alzheimer-s)

Alzheimer's: Specific Causes are being researched, but scientists note a buildup of two abnormal proteins (amyloid and tau), which damage nerve cells in the brain. The proteins form different types of clumps, plaques or tangles, which interfere with how brain cells work and communicate with each other. Plaques are usually first seen in the area of the brain that makes new memories (the hippocampus of the medial temporal lobe), but then moves to other parts of the brain as the disease progresses.

**3.4.3.2.2 Auditory Discrimination**[**§**](http://www.w3.org/TR/coga-user-research/#auditory-discrimination-1)

Whenever the temporal part of the brain becomes diseased, people with dementia have difficulty making sense of sounds. They may lose the ability to follow conversations or become abnormally sensitive to sound. People can also become uncertain about the location of sounds. Social situations and music may be more difficult to enjoy.

**3.4.3.2.3 Visual Recognition Skills**[**§**](http://www.w3.org/TR/coga-user-research/#visual-recognition-skills-2)

In Posterior Cortical Atrophy, a rare form of Alzheimer's, the parietal and occipital lobes of the brain are affected by the same abnormal proteins found in Alzheimer's. This causes difficulty in seeing where and what things are.

**3.4.3.2.4 Phoneme Processing**[**§**](http://www.w3.org/TR/coga-user-research/#phoneme-processing-1)

In fronto-temporal dementia, the temporal lobe is affected, causing difficulty with speech and language.

**3.4.3.2.5 Cross-modal Association**[**§**](http://www.w3.org/TR/coga-user-research/#cross-modal-association-1)

People with Alzheimer's disease have a buildup of abnormal proteins in the hippocampus, which causes it to malfunction. This affects the ability to recognize places. They may become disoriented.

**3.4.3.2.6 Working Memory**[**§**](http://www.w3.org/TR/coga-user-research/#working-memory-1)

In Alzheimer's disease, the buildup of abnormal proteins in the Hippocampus affects the ability to store new memories.

When the temporal lobe is affected by fronto-temporal dementia, it causes difficulty in recollection of factual information.

**3.4.3.2.7 Behavioral**[**§**](http://www.w3.org/TR/coga-user-research/#behavioral)

Fronto-temporal dementia is thought to be caused by proteins building up in the frontal lobe of the brain. People often experience changes in personality and behave inappropriately.

**3.4.3.2.8 Physical**[**§**](http://www.w3.org/TR/coga-user-research/#physical)

In corticobasal degeneration, the cortex and basal ganglia become damaged, which is currently thought to occur due to the overproduction of the tau protein. This causes movement to be stiff or jerky, and affects one or more limbs.

**3.4.3.2.9 Consciousness**[**§**](http://www.w3.org/TR/coga-user-research/#consciousness)

Dementia with Lewy bodies affects the cerebrum where small round lumps of proteins build up, and can cause fluctuations of consciousness, as well as hallucinations, delusions (firmly held beliefs in things that are not real), and false ideas (such as paranoia).

**3.4.4 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-3)

**Overview**: The parts of the brain affected and the specific symptoms depend upon the type of dementia.

**3.4.4.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-1)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. To be determined

**3.4.4.2 Common Symptoms of Cognitive Decline Due to Both Aging and Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#common-symptoms-of-cognitive-decline-due-to-both-aging-and-dementia)

1. Difficulty remembering information (tends to fluctuate as the day progresses, and decline over long periods of time).
2. Difficulty with organizing thoughts.
3. Difficulty working within time limits.
4. Visual processing difficulties, which can affect the ability to recognize places.

**3.4.4.3 Symptoms of Cognitive Decline Due to Aging**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-of-cognitive-decline-due-to-aging)

1. Memory: Sometimes forget names or appointments, but then remember them later.
2. Problem Solving: May make occasional errors when balancing a checkbook.
3. Completing Tasks: May need occasional help to use the settings on a microwave or to record a television show.
4. Confusion w/ Time or Place: May get confused about the day of the week, but then figures it out later.
5. Visual/Spatial/Temporal Understanding: May have vision changes related to cataracts, low vision, and/or color/contrast perception. May have some hearing or speech loss. May have diminished motor ability and acuity. May want/need to combine "Confusion w/ Time or Place" and "Visual/Spatial/Temporal Understanding".
6. Conversation: Sometimes have trouble finding the right word.
7. Misplacing Items: May misplace things from time to time, and then need to retrace their steps to find them.
8. Judgment: May make a bad decision once in a while.
9. Withdrawal: May, on occasion, feel weary of work, family, and social obligations.
10. Mood/Personality: May develop very-specific ways of doing things, and therefore may become irritable when a routine is disrupted.

**3.4.4.4 Symptoms of Cognitive Decline Due to Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-of-cognitive-decline-due-to-dementia)

**3.4.4.4.1 Symptoms of Alzheimer's**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-of-alzheimer-s)

1. Memory: Often or completely forgetting names or appointments.
   1. Forgetting recently-learned information.
   2. Forgetting important dates or events.
   3. Asking for the same information over and over.
   4. Forgetting to check expiration dates on food.
   5. May have problems recognizing familiar faces of family or friends.
   6. Increasing need to rely on memory aids (e.g., reminder notes or electronic devices) or family members for things they used to handle on their own.
2. Problem Solving: Changes in ability to develop and follow a plan; or work with numbers.
   1. May have trouble following a familiar recipe, or keeping track of monthly bills.
   2. May have difficulty concentrating and take much longer to do things than they did before.
3. Completing Tasks: Often find it hard to complete daily tasks.
   1. May have trouble driving to a familiar location.
   2. May have trouble managing a budget.
   3. May have trouble remembering the rules of a favorite game.
   4. May have difficulty in completing tasks that involve multiple steps (ex. laundry).
4. Confusion w/Time or Place: Can lose track of dates, seasons, their location, and the passage of time.
   1. May have trouble understanding something if it is not happening immediately.
   2. May forget where they are or how they got there.
5. Visual/Spatial/Temporal Understanding: May have difficulty reading; speaking; hearing; judging distance; and determining color or contrast. Often have diminished-motor ability and acuity. This may cause problems with driving.
   1. May have difficulty understanding/distinguishing mechanical and electronic sounds and alerts. (including some of the very tools that are meant as memory aids) May want/need to combine "Confusion w/ Time or Place" and "Visual/Spatial/Temporal Understanding".
6. Conversation: Often have trouble following or joining a conversation.
   1. May stop in the middle of a conversation, and have no idea how to continue, or may repeat themselves.
   2. May struggle with vocabulary, have problems finding the right word, or call things by the wrong name (e.g., calling a "watch" a "hand-clock").
   3. May lose ability to speak.
7. Misplacing Items: Often put things in unusual places.
   1. Often lose things, and are unable to go back over their steps to find them again.
   2. Sometimes may accuse others of stealing their misplaced items (may occur with increasing frequency).
8. Decreased Judgment: Experience changes in judgment or decision-making.
   1. Often use poor judgment when dealing with money, giving large amounts to telemarketers.
   2. Often pay less attention to grooming or keeping themselves clean.
9. Withdrawal: May start to remove themselves from hobbies, social activities, work projects, or sports.
   1. May have trouble keeping up with a favorite sports team, or remembering how to complete a favorite hobby.
   2. May avoid being social because of the changes they have experienced.
10. Mood/Personality: Can become confused, suspicious, depressed, fearful, or anxious.
    1. May be easily upset at home, at work, with friends, or in places where they are out of their comfort zone.
11. Confabulation: 'the production of statements or actions that are unintentionally incongruous to the subject's history, background, present and future situation" Dalla Barba (1993).

**3.4.4.4.2 Symptoms of Less-Common Dementia (Non-Alzheimer's)[§](http://www.w3.org/TR/coga-user-research/" \l "symptoms-of-less-common-dementia-non-alzheimer-s" \o "Permalink for symptoms-of-less-common-dementia-non-alzheimer-s)**

1. Memory: Sometimes forgetting names or appointments; and sometimes remembering them later.
2. Problem Solving: Make occasional errors when balancing a checkbook.
3. Completing Tasks: Often need help to use the settings on a microwave or to record a television show.
4. Confusion w/ Time or Place: May get confused about dates, seasons, their location, and passage of time, which usually comes back to them.
5. Visual/Spatial/Temporal Understanding: May have difficulty reading; speaking; hearing; judging distance; and determining color or contrast. May have diminished motor ability and acuity. May want/need to combine "Confusion w/ Time or Place" and "Visual/Spatial/Temporal Understanding".
6. Conversation: On occasion, may have trouble following or joining a conversation. Sometimes, may have problems finding the right word.
7. Misplacing Items: May put things in unusual places, but can usually find them by retracing their steps.
8. Decreased Judgment: On occasion, may experience changes in judgment or decision-making.
9. Withdrawal: May, on occasion, withdraw from work or social activities
10. Mood/Personality: May, on occasion, become confused, suspicious, depressed, fearful, or anxious.

**3.4.4.5 Typical behaviors exhibited by people with Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#typical-behaviors-exhibited-by-people-with-dementia)

1. Repetitive Behavior - Asking the same question over and over again. As well as memory loss, this can be due to the people's feelings of insecurity, or anxiety about their ability to cope.
   1. Repetitive phrases or movements - This can be due to noisy or stressful surroundings; or boredom. It can also be a sign of discomfort, e.g., too hot or cold.
   2. Repetitive actions - Actions, such as repeatedly packing and unpacking a bag, or rearranging chairs in a room, may relate to a former activity.
   3. Repeatedly asking to go home - This can be a sign of anxiety, insecurity, fear, or depression. The concept of 'home' might evoke memories of a time or place of comfort and safety. People may not recognize their present environment as their home, even if it is the place where they live.
   4. Multiple phone calls - Some people with dementia phone their loved ones over and over again, particularly in the middle of the night. They may forget they have already called; or may be insecure or anxious.
2. Restlessness
   1. Pacing up and down - Pacing may indicate a desire to use the toilet, but an inability to say that. Alternatively, pacing may indicate a feeling of frustration, and wanting some fresh air.
   2. Fidgeting - Someone with dementia may fidget constantly.
3. Shouting and Screaming
   1. People may continually call out for someone; shout the same word; or scream or wail over and over again. They could be experiencing difficulties with visual perception or hallucinations.
   2. People with dementia may feel lonely or distressed. If their short term memory is damaged, they may not remember that someone is in the next room, and believe they are alone. They may feel anxious about their failing memory; bored; or stressed by too-much noise and bustle.
4. Lack of inhibition
   1. Some people with dementia may undress in public, having forgotten when and where it is appropriate to remove their clothes.
   2. Apparently-inappropriate sexual behavior may be a result of the physical damage to the part of the brain that allows recognition of acceptable social behaviors.
   3. Some actions, such as lifting a skirt or fiddling with flies, may simply be a sign that the person wants to use the toilet.
   4. The person may behave rudely, for example, by insulting people, by swearing, or by spitting.
5. Night-time Waking
   1. Many people with dementia are restless at night, and find it difficult to sleep. Older people often need less sleep than younger people in any case. Dementia can affect people's body clocks. They may get up in the night, get dressed, or even go outside.
6. Trailing and Checking
   1. Living with dementia makes many people feel extremely insecure and anxious. This can result in constantly following their carers or loved ones around, or calling out to check where they are. A few moments may seem like hours to a person with dementia. They may feel safe only if other people are nearby.
7. Hiding and Losing things
   1. People with dementia sometimes hide things and then forget where they are, or forget they have hidden them at all. The wish to hide things may be due to feelings of insecurity, and a desire to hold on to what little they still have.
8. Suspicion
   1. Some people with dementia can become suspicious. If they have mislaid an object, they may accuse someone of stealing it, or they may imagine that a friendly neighbor is plotting against them. These ideas may be due to failing memory, or an inability to recognize people,
9. Sleeplessness and ‘sundowning'
   1. Many people with dementia, especially in the middle stages, experience periods of increased confusion at dusk, with their disorientation continuing throughout the night. These periods, of what is known as 'sundowning', usually diminish as dementia progresses. (1)

**3.4.5 ICT Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#ict-challenges)

**3.4.5.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-2)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. Design recommendations for tv user interfaces for older adults: findings from the eCAALYX project, ASSETS '12 Proceedings of the 14th international ACM SIGACCESS conference on computers and accessibility, 41-48, F. Nunes, M. Kerwin, P Alexandra-Silva, 2012. (Contributed by Katherine Deibel)
2. How voice augmentation supports elderly web users, ASSETS '11 The proceedings of the 13th international ACM SIGACCESS conference on computers and accessibility, 155-162, D. Sato, M. Kobayashi, H. Takagi, C. Asakawa, J. Tanaka, 2011. (Contributed by Katherine Deibel)

**3.4.5.2 Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#challenges-3)

* Remembering steps to complete a task, e.g., "How do I send an email?"
* Overwhelmed by too many functions, complex UIs.
* Copying information correctly.
* Difficulty figuring out new UI metaphors.
* Too many steps to complete a task.
* Advertising prompts added before getting to a web page are confusing.
* Menu systems are difficult to navigate and find the right path.
* 15% of people living with dementia, an estimated 112,500 people (in the UK), have been victims of financial abuse, such as cold calling, scam mail, or mis-selling.
* 62% of carers reported that the person they care for had been approached by cold callers or doorstep-sales people.
* 70% reported that telephone callers routinely targeted the person they care for. Not only have people lost money, but they and their families have also suffered stress, exhaustion, and frustration as a result.
* 76% of people reported having trouble managing their money, with a range of issues highlighted, such as the challenges of bank-security procedures; and a lack of dementia awareness in banks and other financial-services organizations. UK ONLY (4)
* Mood/Personality: Controlling confusion and irritability when changes are made to their routine, environment, or location. Difficulty in feeling safe.

**3.4.6 Scenarios and Use Cases that address Key ICT Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#scenarios-and-use-cases-that-address-key-ict-challenges)

**3.4.6.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-3)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. Understanding the role of age and fluid intelligence in information search, ASSETS '12 Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility, 119-126, S. Trewin, J.T. Richards, V.L. Hanson, D. Sloan, B.E. John, C. Swart, J.C. Thomas, 2012. (Contributed by Katherine Deibel)
2. Basic senior personas: a representative design tool covering the spectrum of European older adults, ASSETS '12 Proceedings of the 14th international ACM SIGACCESS conference on computers and accessibility, 25-32, B. Wockl, U. Yildizoglu, I. Buber, B. Aparicio-Diaz, E. Kruijff, M. Tscheligi, 2012. (Contributed by Katherine Deibel)
3. How voice augmentation supports elderly web users, ASSETS '11 The proceedings of the 13th international ACM SIGACCESS conference on computers and accessibility, 155-162, D. Sato, M. Kobayashi, H. Takagi, C. Asakawa, J. Tanaka, 2011. (Contributed by Katherine Deibel)

**3.4.6.2 Scenarios**[**§**](http://www.w3.org/TR/coga-user-research/#scenarios)

* Struggling to remember recent events, but easily recalling things from the past.
* Finding it hard to follow conversations or programs (on TV, web, video, webcast).
* Forgetting the names of friends or everyday objects.
* Repeating themselves, or losing the thread of what they are saying.
* Problems with thinking and reasoning.
* Feeling anxious, depressed, or angry about forgetfulness.
* Other people starting to comment on their forgetfulness.
* Confused, even when in a familiar environment (in space; and on TV, web, video, webcast).
* A decline in the ability to talk, read or write.

**3.4.6.2.1 Scenario A: Sending an Email**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-a-sending-an-email)

Scenario A is an elderly person who has limited familiarity with computer devices (desktop, tablets, mobile). A would like to send an email to a family member. A needs to be able to find the mail program easily, interact with the user interface to compose and send an email, know that it has been sent, and then know if the email has been replied to. A starts by turning on the computer.

|  |  |
| --- | --- |
| Steps and Challenges for booking a train ticket online. | |
| **Step** | **Challenges** |
| Turn on computer. | Identify and press the power button to turn the computer on. This may be difficult for a number of reasons. Firstly, people may find it hard to identify the power button, as they may have forgotten what it looks like. Secondly, some power buttons can be quite small, which may be difficult for elderly people to press, especially those who have arthritis or a tremor in their hands. |
| Launch email application. | This requires people to be able to identify the correct icon for their email application. Although there is a certain amount of intuitiveness surrounding the design of icons, sometimes, for the elderly, this can still be a problem. In this case, typing in the name of the email application (if that can be remembered) into the search bar on the start-up menu may help. |
| Select button to compose new email. | The majority of buttons with an email application are labeled. Therefore, people simply must read the icon labels until they find the correct one for 'new email' |
| Type in address of recipient. | If people are unable to remember the email address of the recipient, they can type the address in the box labeled "To". If people must access their address book to find the email address, they must select the address book (or contacts list) icon, and then type in the name of the person they wish to email. Their address should then come up. All of the above requires recognition and retrieval of information from long term memory, which could be a problem for those with memory problems. |
| Type in email subject. | Type a title for email into the subject box. This field is not mandatory. Therefore, if people are unable to enter any text in this field, the actual sending of the email will not be affected. However, most applications will show a warning message, such as "do you wish to send this email without a subject". People will still be enable to press "send" successfully. |
| Type content of email. | This should be fairly simple, provided people can remember what they wished to say in their email. |
| Send email. | The majority of email applications will have a clearly-labeled button for sending email. |
| Return to in-box. | In the majority of email applications, this step happens automatically after an email has been sent. |
| Minimize email application to background. | By selecting the third button from the left, in the top right-hand corner of the email application, people are able to minimize their emails. However, if people cannot remember what the "minimize" button looks like, or where it is located, this could be a problem for them. |
| Open email application from time to time to check if reply has been received. | The challenges associated with this step will be the same as the challenges associated with step 2. |

**3.4.6.2.2 Scenario B: Buying a Train Ticket Online**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-b-buying-a-train-ticket-online)

Scenario B is a gentleman in his early 50s who has recently been diagnosed with fronto-temporal dementia (early onset). He is trying to buy a train ticket online for a return journey the following day. At any point during this process, he may forget what he is doing, which could result in either no ticket being purchased or, alternatively, buying the wrong ticket. For example, he may wish to travel tomorrow, but purchase a ticket for the following week.

|  |  |
| --- | --- |
| Steps and Challenges for booking a train ticket online. | |
| **Step** | **Challenges** |
| Turn on computer. | Identify and press the power button to turn the computer on. This may be difficult for a number of reasons. Firstly, people may find it hard to identify the power button, as they may have forgotten what it looks like. To extend this further, people may have entirely forgotten what the computer is for, or where to find it. In this instance, the task becomes impossible until their memory returns. Secondly, some power buttons can be quite small. This may be difficult for those with reduced dexterity, particularly for those who are older, and may have arthritis or a tremor. |
| Open Internet browser. | Navigate home screen with mouse, identify web-browser icon, and select to open. Typical memory problems. |
| Type in URL for train ticket booking website. | Typing in the first few letters of the web address in the search bar should produce the URL. |
| Select icon for booking train tickets. | If the icon is not labeled, this could be difficult if people forget what the icon to buy tickets looks like. However, most icons for booking train tickets are clearly labeled. Therefore, the only issues for people should be recognizing the correct label, and remembering what they are doing. |
| Tick box for 'return'. | The user needs to remember that they need to purchase a return ticket in order to get home. |
| Type in from and to destinations. | Given that people start from their home address, it can be hoped their nearest train station is securely stored in their long term memory, and can be remembered. With regards to the destination, they are likely to have written this down when arranging the outing, which should help them remember the destination. |
| Select date and time for outbound & return journeys. | Choosing appropriate times for travel may be difficult for people with dementia. However, most train-ticket-booking websites do not allow booking a return journey prior to an outbound journey, so at least this potential problem is guarded against. |
| Select number of adult & child passengers. | In this instance, only 1 person is traveling. However, when more than 1 person is traveling, there is a higher possibility of the wrong number of tickets being purchased. |
| Tick box for rail cards. Select rail-card type and number that apply for this journey. | People are likely to have a rail card for seniors or persons with disabilities. Therefore, they must remember to apply their rail-card discount to the journey in order to get a discount. |
| Select continue. | - |
| Tick box for outward & return journeys (Details to look at: time, price, class, & single/return.). | This step involves selecting which type of ticket to purchase. Although all options are laid out in a table, sometimes it can be difficult to work out exactly which ticket to buy, and how much it costs. |
| Select 'buy now'. | - |
| *Tick box to reserve seat and, if so, select seating preferences.* This is optional. Therefore, if people do not understand it, it is perfectly fine for them to ignore this step. |  |
| Tick box to either: collect tickets from self-service ticket machine and select station; or have tickets sent by post. | Self-service ticket machines tend to be fairly complicated. Therefore, as long as there is enough time (7 days prior to start of journey), it is advisable to have the tickets sent by post. |
| Select 'continue'. | - |
| Tick box 'new user'. | If people have not used this particular ticket-booking site, they must enter all their personal details. Otherwise, they just need to remember their email address and password. |
| Type in personal details (Name, Address, Email, etc.). | Personal details need to be remembered. |
| Tick box 'payment card type' (Visa, MasterCard, etc.). | On the payment card, there is a symbol to indicate which type of card it is. This information must be entered by way of ticking the correct box. |
| Enter card details (number, expiration date, name, security code). | These are written on the payment card so there is no issue with memory impairment here. However, as with each step throughout this process, if people forget what they are trying to achieve at any point, they are unlikely to be successful in this task. |
| Type in post code and tick box find billing address. |  |
| Tick box to agree to terms and conditions and select 'buy now' |  |
| Enter payment card secure-bank password. |  |
| Order complete. |  |

**3.4.6.2.3 Scenario C: Online Supermarket Shop**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-c-online-supermarket-shop)

Scenario C is a woman with dementia in her early 70s. She finds it easier to do her supermarket shopping online because she often gets confused in the shop, and forgets what she wants to buy.

|  |  |
| --- | --- |
| Steps and Challenges for changing the payment details for an online supermarket shop. | |
| **Step** | **Challenges** |
| Turn on computer. | Identify and press the power button to turn the computer on. This may be difficult for a number of reasons. Firstly, people may find it hard to identify the power button as they may have forgotten what it looks like. Secondly, some power buttons can be quite small, which may be difficult for elderly people to press, especially those who have arthritis or a tremor in their hands. |
| Open web browser. | Navigate home screen with mouse, identify web-browser icon, and select to open. Typical memory problems. |
| Type in URL for supermarket shopping website. | Typing in the first few letters of the web address in the search bar should populate with previous history. However, if it is the first time, people may not understand how the automatic population of text works. |
| Select 'food and drink', and then 'buy groceries'. | Finding products and selecting a quantity may pose difficulty depending upon the user interface. |
| Log in with user name and password. | It may be difficult to remember the user name and password associated for this online store. |
| Delete old payment card |  |
| Select 'add payment card'. |  |
| Type in the card details. | These are written on the payment card so there is no issue with memory impairment here. However, as with each step throughout this process, if people forget what they are trying to achieve at any point, they are unlikely to be successful in this task. |
| Tick box 'make this my preferred payment card'. |  |
| Select 'save', and then either continue shopping or log out. |  |

**3.4.6.3 User Stories**[**§**](http://www.w3.org/TR/coga-user-research/#user-stories)

**3.4.6.3.1 Scenario A: Send an Email**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-a-send-an-email)

Assumption: People have the screen in front of them, and it is already turned on.

Scenario A is an elderly person who has limited familiarity with computer devices (desktop, tablets, mobile). A would like to send an email to a family member. A needs to be able to find the mail program easily, interact with the user interface to compose and send an email, know that it has been sent, and then know if the email has been replied to. A turns on the computer.

|  |  |  |  |
| --- | --- | --- | --- |
| Table of ICT Steps and Challenges for Sending an Email | | | |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Find the mail program. | Search to find. What's the name/icon for the mail program? |  |  |
| 2. Activate/open the program. | Remember how to start up. |  |  |
| 3. Navigate the UI | Familiarize/remind themselves how to use it, understand icons/text labels, and understand how to increase the font size. |  |  |
| 4. Locate email editor. | Remember/find correct name for composing (compose, new). |  |  |
| 5. Familiarize with the fields. | Remember what each is used for/find the ones that are really needed vs. optional. |  |  |
| 6. Insert Email addresses. | How do I do that? What is an email address and what is its format?  Trouble remembering the name or email address for the person to send note to; confusion with pre-populating and word prediction; interaction with the Contacts feature; understand or ignore CC and BCC fields (solution: keep out); how to fix a wrongly-entered email address. |  |  |
| 7. Subject Line | Know that one is needed. | Maybe pre-populate. |  |
| 8. Write the Email. | Not know/understand email conventions, confusion with spell checking; not understand editor features (bold, italic, color); challenges with adding an image/file; not know how to edit what has been written or how to start over; confusion if time-out occurs. | Spell check - maybe turn off by default. |  |
| 9. Send the email. | Knowing when done (After it goes, where does it go, waiting for the recipient to respond immediately - is it like a phone call?). |  |  |
| 10. Closing the Program. | Remember how to do that, remembering that is needed. |  |  |
| 11. Getting a Reply. | How to know there is one? |  | May be out of scope for this use case. |

**3.4.6.3.2 Scenario B: Turn up the Heat (using thermostat app).**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-b-turn-up-the-heat-using-thermostat-app-.x)

Assumptions: People know they can do this from a remote device; they have the screen in front of them; it is already turned on.

Scenario B is an elderly person with early dementia. A daughter has demonstrated how to use a web-enabled mobile application to change the temperature of the house. Winter has arrived. B would like to turn the heat up to keep the house warm enough. B needs help recalling how to access the temperature program, the work flow to change the temperature, and understand the elements of the user interface.

|  |  |  |  |
| --- | --- | --- | --- |
| Table of ICT Steps and Challenges for Turning up the Heat | | | |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Find the thermostat program (e.g., Nest). | Search to find that control, remember what the control is called, remember where it is. |  |  |
| 2. Activate/open the program. | Remember how to start up. |  |  |
| 3. Navigate the UI. | Familiarize/remind themselves with it, understand icons/text names, understand how to increase font size. |  |  |
| 4. Locate Temperature Control Feature. | Remember/find correct name for changing (many UI versions, might be slider, button - how to use that - maybe unfamiliar non-intuitive for them), understand icons/text labels. |  |  |
| 5. Manipulate the control up or down. | How to control the level of the heat. (Is there a 2nd control?) Is that in degrees F or C? How to use/understand a slider feature? |  |  |
| 6. Setting the desired temperature. | How to do that? Understanding that a change has been set: does it save it automatically or does something have to be done to save it? Confusion if time-out occurs. |  |  |
| 7. Closing the Program. | Remember how to do that. Remembering that it needs to be done. |  |  |

**3.4.6.4 Personas**[**§**](http://www.w3.org/TR/coga-user-research/#personas)

* "I have great difficulty remembering things, working things out, and interpreting things. I use a Dictaphone, which helps considerably. I can't use a normal watch so I've gone digital, but that has its limitations. I can't read very well so I use audio books. I can't count money, but I haven't found a way around that yet, so any suggestions will be gratefully received! So, I've developed strategies to help. These can be very simple but effective if they work. Often, it is the simplest things that get the better of us - things we have done all our lives without a problem. But now, because we can't do them, it is very frustrating." - Extract from a speech by Ann Johnson at the Uk Dementia Congress, November, 2010.

**3.4.7 How they use the web and ICT to include: email, apps, voice systems, IM.**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict-to-include-email-apps-voice-systems-im.x)

**3.4.7.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-4)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. To be determined

**3.4.7.2 {Section}**[**§**](http://www.w3.org/TR/coga-user-research/#section)

*To do: Add table.*

**3.4.8 How people with Aging and Dementia can use optimized content and special pages.**[**§**](http://www.w3.org/TR/coga-user-research/#how-people-with-aging-and-dementia-can-use-optimized-content-and-special-pages.x)

*To do: Add examples with descriptions of features that could optimize content for users.*

**3.4.8.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-5)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. To be determined

**3.4.9 Characteristics of Content Optimized for Aging and Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-aging-and-dementia)

Content for people with dementia and the elderly with cognitive decline:

1. large, clear buttons with simple graphics and text;
2. limited features;
3. high contrast;
4. clear, step-by-step instructions;
5. rapid and direct feedback;
6. simple, clear-writing style.

(Conclusions from The 14th international conference ICCHP 2014 - see below.)

**3.4.9.1 Summary of Existing Research and Guidelines - Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines---research-sources)

Key features from Phiriyapkanon:

1. Reduction of complexity: Factions that are rarely used, or are not necessary, should be removed.
2. Clear structure of task: The starting points of tasks and every step should be easily recognized and understood.
3. Consistency of information: Avoid contradictions and inconsistencies of information arraignment.
4. Rapid and direct feedback: Applications should continuously provide easily-recognizable feedback of success or failure with every action.

They also should minimize errors; and provide on-screen help and high recover-ability. *Phiriyapkanon. Is big button interface enough for elderly users, P34, Malardardalen University Press Sweden 2011*.

K Dobsz et. al. recommends:

1. strong contrast of images with content;
2. simple and large graphics;
3. sound conformation of accepted and rejected operations;
4. automatic-voicing reading tasks (instructions).

*Computers helping people with special needed, 14 international conference ICCHP 2014 Eds. Miesenberger, Fels, Archambault, Et. Al. Springer (pages 401). Paper: Tablets in the rehabilitation of memory impairment, K Dobsz et. al.*

Key features from other guidelines:

1. To help with difficulties in completing complex tasks, waiting until the elder completes one task before proceeding to the next step.
2. Place tasks in step-by-step order.

Balance this because too-many steps can give a feeling of getting lost.

1. One has to be consistent in naming steps, such as naming all steps beginning with a verb (such as "press the button").
2. **Orientation** impairments cause elderly to unlearn how to find their way in new surroundings. Therefore:
   1. Menus and usability interfaces need to be simplified to minimize the amount of information that needs to be memorized.
   2. An application should work independent of other applications.
   3. The screen should not have distracting elements (wallpaper, buttons etc.).
3. Information should be broken down into discreet chunks that the elderly can absorb.
4. Content and information need to be consistent.
5. Avoid stress that will further impair cognitive function.

*Computers helping people with special needs, 14 international conference ICCHP 2014 Eds. Miesenberger, Fels, Archambault, et. al. Springer (pages 401). Paper: Never Too old to use a tablets, L. Muskens et. al. pages 392 - 393.*

Key features for using tablets for the elderly from Dahn et. al.:

1. The user interface should use widgets or large buttons rather then standard apps. Moving between screens should be possible using tabs or buttons, and not just gestures.
2. Dedicated user interfaces often fall short of user requirements. Instead, populate the tablet with standard apps that have simple interfaces.
3. Offer a PC-like mode with "file explorer" and familiar PC-interface features.
4. Supply a printed manual.
5. Privacy policies should be transparent to build trust.
6. Supply a scaffolding approach to help and support, but allow flexible-entry points.

*Computers helping people with special needs, 14 international conference ICCHP 2014 Eds. Miesenberger, Fels, Archambault, et. al. Springer (part 2 page 329). Paper: Supporting senior citizens in using tablet computers, Dahn et. al.* .

1. **Older Equipment and Software:** Some people who are aging or have dementia will be using older browsers and devices that might not be as capable or fault tolerant as current technologies; or may be missing some of the customized and interactive content provided by newer technologies.

**3.4.10 Specific Technologies**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies-3)

*To do: Add section*

**3.4.10.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-6)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. How voice augmentation supports elderly web users, ASSETS '11 The proceedings of the 13th international ACM SIGACCESS conference on computers and accessibility, 155-162, D. Sato, M. Kobayashi, H. Takagi, C. Asakawa, J. Tanaka, 2011. (Contributed by Katherine Deibel)

**3.4.11 Summary of Existing Research and Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines-1)

*To do: Add literary summary and insert guidelines and or references.*

**3.4.11.1 Use of Language and Communication for Dementias**[**§**](http://www.w3.org/TR/coga-user-research/#use-of-language-and-communication-for-dementias)

[[#LANG](https://www.w3.org/WAI/PF/cognitive-a11y-tf/wiki/Gap_Analysis/Aging_and_Dementia#LANG)]

* Avoid use of voice recognition or spoken commands from the end-user.
* In either spoken or written information, use simple words, avoiding abstract, unfamiliar vocabulary.
* In either spoken or written information, use simple sentences with just one idea per sentence. Avoid long sentences with embedded ideas.
* Avoid pronouns or other forms of language that rely upon people having to recall information which they have just read or heard.
* Support writing with clear visual images to account for potential vision deficits that have an impact on reading ability.

**3.4.12 Extent to which current needs are met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-3)

Review challenges and describe where needs are met. Identify gaps.

**3.4.13 Potentials and Possibilities (including current WCAG 2 Techniques)[§](http://www.w3.org/TR/coga-user-research/" \l "potentials-and-possibilities-including-current-wcag-2-techniques" \o "Permalink for potentials-and-possibilities-including-current-wcag-2-techniques)**

**Overview:** This section maps higher-level challenges to existing WCAG 2 Techniques so that we can see where there are clear gaps that we will need to provide techniques for.

**3.4.13.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-7)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. To be determined

**3.4.13.2 {Section}**[**§**](http://www.w3.org/TR/coga-user-research/#section-1)

Add ideas for filling gaps.

1. **Memory:**
   1. enhanced use of color
      1. **1.4.1 - Use of Color (A)** requires that color is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. **Perceivable**
   2. Context and Orientation
      1. **2.4.3 - Focus Order (A)** says "components receive focus in an order that preserves meaning and operability". **Operable**
      2. **2.4.7 - Focus Visible (AA)** requires an ability for the "keyboard focus indicator (to be) visible". **Operable**
      3. **2.4.4 - Link Purpose (In Context) (A)** requires that the purpose of a link can be determined from the link text alone, or from the link text together with its surrounding context. **Operable**
      4. **2.4.9 - Link Purpose (Link Only) (AAA)** says "a mechanism is available to allow the purpose of each link to be identified from link text alone". **Operable**
      5. **2.4.7 - Focus Visible (AA)** requires a visible keyboard focus indicator that shows which component on the web page has focus. **Operable**
      6. **2.4.8 - Location (AAA)** says "information about the user's location within a set of Web pages is available". **Operable**
      7. **2.4.2 - Page Title (A)** says "web pages have titles that describe topic or purpose". (This is important for search results as the page title is usually displayed first in the listing.) **Operable**
   3. prompts and cues;
   4. index or table of contents;
   5. support text with redundant visual and auditory elements.
      1. **1.1.1 - Non-text Content (A)** says "a text alternative that serves the equivalent purpose" is required. **Perceivable**
      2. **1.3.1 - Info and Relationships (A)** says "information, structure, and relationships" to be made available, for example to text-to-speech software. **Perceivable**
      3. Software that visually highlights spoken text.
   6. help index
   7. Context Sensitive (support and) Help
      1. **3.1.3 Unusual Words (Level AAA)** **Understandable**
      2. **3.1.4 Abbreviations (Level AAA)** **Understandable**
   8. grouping and symmetry (to leverage visual perception and attention);
   9. intuitive design - ease of interaction (to leverage spatial memory);
      1. **2.1.1 - Keyboard (A)** says "the content is operable through a keyboard interface". **Operable**
      2. **2.1.2 - No Keyboard trap (A)** makes sure that keyboard focus "can be moved away from that component using only a keyboard". **Operable**
      3. **2.1.3 - Keyboard (No Exception) (AAA)** says "all functionality of the content is operable through a keyboard interface". **Operable**
      4. **2.4.1 - Bypass Blocks (A)** says "a mechanism is available to bypass blocks of content that are repeated". **Operable**
      5. **2.4.3 - Focus Order (A)** says "components receive focus in an order that preserves meaning and operability". **Operable**
      6. **2.4.7 - Focus Visible (AA)** requires an ability for the "keyboard focus indicator (to be) visible". **Operable**
      7. **3.3.2 - Labels or Instructions (A)** says that labels should be provided "when content requires user input". **Understandable**
   10. Consistent Navigation
       1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
   11. consistent identification;
   12. simplified user controls;
   13. error prevention and recovery;
   14. avoid distractions and seizures.
       1. **1.4.2 - Audio Control (A)** says "a mechanism is available to pause or stop the audio". **Perceivable**
       2. **2.2.2 - Pause, Stop, Hide (A)** says "a mechanism for the user to pause, stop, or hide" moving or blinking content. **Operable**
       3. **2.2.4 - Interruptions (AAA)** says "interruptions can be postponed or suppressed". **Operable**
       4. **2.3.1 - Three Flashes or Below Threshold (A)** **Operable**
       5. **2.3.2 Three Flashes (AAA)** **Operable**
2. **Problem Solving:**
   1. Content Alternatives
      1. **1.1.1 - Non-text Content (A**) **Perceivable**
      2. **1.2.1 - Audio-only and Video-only (Prerecorded) (A)** **Perceivable**
      3. **1.2.2 - Captions (Prerecorded) (A)** **Perceivable**
      4. **1.2.3 - Audio Description or Media Alternative (Prerecorded video) (A)** **Perceivable**
      5. **1.2.4 - Captions (Live) (A)** **Perceivable**
      6. **1.2.5 - Audio Description (Prerecorded video) (AA)** **Perceivable**
      7. **1.2.7 - Extended Audio Description (Prerecorded video) (AAA)** **Perceivable**
      8. **1.2.8 - Media Alternative (Prerecorded) (AAA)** **Perceivable**
      9. **1.2.9 - Audio-only (Live) (AAA)** **Perceivable**
      10. **1.4.7 - Low or No Background Audio (Prerecorded) (AAA)** **Perceivable**
   2. prompts and cues;
   3. logical work flow with redundant text, visual cues, and auditory cues;
   4. grouping and symmetry (to leverage visual perception and attention);
   5. intuitive design - ease of interaction (to leverage spatial memory).
   6. Consistent Navigation
      1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
   7. consistent identification;
   8. easy user customization;
   9. simplified user controls;
3. **Completing Tasks:**
   1. prompts and cues;
   2. grouping and symmetry (to leverage visual perception and attention);
   3. intuitive design - ease of interaction (to leverage spatial memory);
   4. easy user customizations.
      1. **1.4.4 - Resize Text (AA)** says "text can be resized without assistive technology up to 200 percent without loss of content or functionality". **Perceivable**
      2. **1.4.8 - Visual Presentation (AAA)** includes requirements on text style, text justification, line spacing, line length, and horizontal scrolling. **Perceivable**
   5. simplified user controls;
   6. error prevention and recovery;
   7. avoid distractions and seizures;
      1. **1.4.2 - Audio Control (A)** says "a mechanism is available to pause or stop the audio". **Perceivable**
      2. **2.2.2 - Pause, Stop, Hide (A)** says "a mechanism for the user to pause, stop, or hide" moving or blinking content. **Operable**
      3. **2.2.4 - Interruptions (AAA)** says "interruptions can be postponed or suppressed". **Operable**
      4. **2.3.1 - Three Flashes or Below Threshold (A)** **Operable**
      5. **2.3.2 Three Flashes (AAA)** **Operable**
4. **Confusion w/ Time or Place:**
   1. Context and Orientation
      1. **2.4.3 - Focus Order (A)** says "components receive focus in an order that preserves meaning and operability". **Operable**
      2. **2.4.7 - Focus Visible (AA)** requires an ability for the "keyboard focus indicator (to be) visible". **Operable**
      3. **2.4.4 - Link Purpose (In Context) (A)** requires that the purpose of a link can be determined from the link text alone, or from the link text together with its surrounding context. **Operable**
      4. **2.4.9 - Link Purpose (Link Only) (AAA)** says "a mechanism is available to allow the purpose of each link to be identified from link text alone". **Operable**
      5. **2.4.7 - Focus Visible (AA)** requires a visible keyboard focus indicator that shows what component on the web page has focus. **Operable**
      6. **2.4.8 - Location (AAA)** says "information about the user's location within a set of Web pages is available". **Operable**
      7. **2.4.2 - Page Title (A)** says "web pages have titles that describe topic or purpose" (this is important for search results as the page title is usually displayed first in the listing). **Operable**
   2. Identify current state.
   3. Consistent Navigation
      1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
   4. consistent identification;
   5. simplified user controls;
   6. error prevention and recovery;
   7. Avoid Distractions and Seizures.
      1. **1.4.2 - Audio Control (A)** says "a mechanism is available to pause or stop the audio". **Perceivable**
      2. **2.2.2 - Pause, Stop, Hide (A)** says "a mechanism for the user to pause, stop, or hide" moving or blinking content. **Operable**
      3. **2.2.4 - Interruptions (AAA)** says "interruptions can be postponed or suppressed". **Operable**
      4. **2.3.1 - Three Flashes or Below Threshold (A)** **Operable**
      5. **2.3.2 Three Flashes (AAA)** **Operable**
5. **Visual/Spatial/Temporal Understanding:** May want/need to combine "Confusion w/ Time or Place" and "Visual/Spatial/Temporal Understanding".
   1. Content Alternatives
      1. **1.1.1 - Non-text Content (A**) **Perceivable**
      2. **1.2.1 - Audio-only and Video-only (Prerecorded) (A)** **Perceivable**
      3. **1.2.2 - Captions (Prerecorded) (A)** **Perceivable**
      4. **1.2.3 - Audio Description or Media Alternative (Prerecorded video) (A)** **Perceivable**
      5. **1.2.4 - Captions (Live) (A)** **Perceivable**
      6. **1.2.5 - Audio Description (Prerecorded video) (AA)** **Perceivable**
      7. **1.2.7 - Extended Audio Description (Prerecorded video) (AAA)** **Perceivable**
      8. **1.2.8 - Media Alternative (Prerecorded) (AAA)** **Perceivable**
      9. **1.2.9 - Audio-only (Live) (AAA)** **Perceivable**
      10. **1.4.7 - Low or No Background Audio (Prerecorded) (AAA)** **Perceivable**
   2. large selection targets;
   3. zoom controls, large fonts.
      1. **1.4.4 - Resize Text (AA)** says "text can be resized without assistive technology up to 200 percent without loss of content or functionality". **Perceivable**
   4. close proximity;
   5. context and orientation.
      1. **2.4.3 - Focus Order (A)** says "components receive focus in an order that preserves meaning and operability". **Operable**
      2. **2.4.7 - Focus Visible (AA)** requires an ability for the "keyboard focus indicator (to be) visible". **Operable**
      3. **2.4.4 - Link Purpose (In Context) (A)** requires that the purpose of a link can be determined from the link text alone, or from the link text together with its surrounding context. **Operable**
      4. **2.4.9 - Link Purpose (Link Only) (AAA)** says "a mechanism is available to allow the purpose of each link to be identified from link text alone". **Operable**
      5. **2.4.7 - Focus Visible (AA)** requires a visible keyboard focus indicator that shows what component on the web page has focus. **Operable**
      6. **2.4.8 - Location (AAA)** says "information about the user's location within a set of Web pages is available". **Operable**
      7. **2.4.2 - Page Title (A)** says "web pages have titles that describe topic or purpose". (This is important for search results as the page title is usually displayed first in the listing.) **Operable**
   6. prompts and cues;
   7. support text with redundant visual and auditory elements;
   8. help index;
   9. context-sensitive help;
   10. plain language;
   11. grouping and symmetry (to leverage visual perception and attention);
   12. intuitive design - ease of interaction (to leverage spatial memory);
   13. consistent navigation.
       1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
   14. consistent identification;
   15. enhanced use of color and contrast.
       1. **1.4.1 - Use of Color (A)** requires that color is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. **Perceivable**
       2. **1.4.3 - Contrast (Minimum) (AA)** requires a contrast ratio of at least 4.5:1 for the visual presentation of text and images. **Perceivable**
       3. **1.4.6 - Contrast (Enhanced) (AAA)** requires a higher contrast ratio of at least 7:1 for the visual presentation of text and images. **Perceivable**
   16. easy user customizations
       1. **1.4.4 - Resize Text (AA)** says "text can be resized without assistive technology up to 200 percent without loss of content or functionality". **Perceivable**
       2. **1.4.8 - Visual Presentation (AAA)** includes requirements on text style, text justification, line spacing, line length, and horizontal scrolling. **Perceivable**
   17. simplified user controls;
   18. error prevention and recovery;
   19. avoid distractions and seizures.
       1. **1.4.2 - Audio Control (A)** says "a mechanism is available to pause or stop the audio". **Perceivable**
       2. **2.2.2 - Pause, Stop, Hide (A)** says "a mechanism for the user to pause, stop, or hide" moving or blinking content. **Operable**
       3. **2.2.4 - Interruptions (AAA)** says "interruptions can be postponed or suppressed". **Operable**
       4. **2.3.1 - Three Flashes or Below Threshold (A)** **Operable**
       5. **2.3.2 Three Flashes (AAA)** **Operable**
6. **Conversation:**
   1. text;
   2. support text with redundant visual and auditory elements;
   3. simplified user controls.
7. **Misplacing Items:**
   1. site map;
   2. index or table of contents;
   3. help index;
   4. context-sensitive help;
   5. consistent navigation.
      1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
   6. consistent identification
8. **Judgment:**
   1. prompts and cues;
   2. support text with redundant visual and auditory elements;
   3. grouping and symmetry (to leverage visual perception and attention).
9. **Withdrawal:**
   1. easy user customizations
      1. **1.4.4 - Resize Text (AA)** says "text can be resized without assistive technology up to 200 percent without loss of content or functionality". **Perceivable**
      2. **1.4.8 - Visual Presentation (AAA)** includes requirements on text style, text justification, line spacing, line length, and horizontal scrolling. **Perceivable**
   2. simplified user controls;
   3. error prevention and recovery;
   4. emotional expression (EmotionML).
10. **Mood/Personality:**
    1. encouragement;
    2. immediate positive feedback;
    3. safety controls;
    4. grouping and symmetry (to leverage visual perception and attention);
    5. consistent navigation.
       1. **2.4.5 - Multiple Ways (AA)** says "more than one way is available to locate a Web page within a set of Web pages". **Operable**
    6. consistent identification;
    7. easy user customizations.
       1. **1.4.4 - Resize Text (AA)** says "text can be resized without assistive technology up to 200 percent without loss of content or functionality". **Perceivable**
       2. **1.4.8 - Visual Presentation (AAA)** includes requirements on text style, text justification, line spacing, line length, and horizontal scrolling. **Perceivable**
    8. simplified user controls;
    9. error prevention and recovery;
    10. emotional expression (EmotionML).

**3.4.14 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-3)

**3.4.14.1 Research Sources**[**§**](http://www.w3.org/TR/coga-user-research/#research-sources-8)

These resources are relevant to this section. For our next draft, components of these articles will be incorporated into this section where applicable.

1. To be determined

**3.4.14.2 Prevalence of Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-of-dementia)

* UK (2013 Study)
  + Alzheimer's Society estimates there are 428,000 people in the UK who are living with dementia that haven't been formally diagnosed.
  + Two thirds of people with dementia are women.
  + One in three people over 65 will develop dementia.
  + 40-64 years: 1 in 1,400
  + 65-69 years: 1 in 100
  + 70-79 years: 1 in 25
  + 80+ years: 1 in 6
  + Future Projections: The number of people in the UK with dementia will double in the next 40 years.
    - 800,000 people with dementia in 2012
    - 1,000,000 people with dementia in 2021
    - 1,700,000 people with dementia in 2051

**3.4.14.2.1 Worldwide**[**§**](http://www.w3.org/TR/coga-user-research/#worldwide)

* There are an estimated 35.6 million people with dementia worldwide. By 2050, this figure will rise to over 115 million. (2)
* There are 7.7 million new cases every year. (9)
* Alzheimer's disease is the most common form of dementia, and may contribute to 60-70% of cases. (9)
* In 2010, dementia had an estimated global cost of US $604 Billion, 1% of global GDP. (3)

**3.4.14.2.2 By Gender**[**§**](http://www.w3.org/TR/coga-user-research/#by-gender)

* A study cited by the European Collaboration on Dementia (EuroCoDe) states that, in Europe, approximately 5 million women have dementia, compared with 2 and half million men. (5) Cognitive decline is often accelerated in women following menopause. (6)

**3.4.14.3 Prevalence of Aging**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-of-aging)

* World Health Organization: 2012 Study
  + The world population is rapidly aging.
    - Between 2000 and 2050, the proportion of the world's population over 60 years old will double, from about 11% to 22%. The number of people aged 60 years and over is expected to increase from 605 million to 2 billion over the same period.
  + The number of people aged 80 and older will quadruple in the period 2000 to 2050.
    - By 2050, the world will have almost 400 million people aged 80 years or older.
  + By 2050, 80% of older people will live in low- and middle-income countries.
  + The main health burdens for older people are from non-communicable diseases, while the greatest causes of disability are visual impairment, dementia, hearing loss, and osteoarthritis.
  + Older people in low- and middle-income countries carry a greater disease burden than those in the rich world.
  + The need for long-term care is rising.
    - The number of older people, who are no longer able to look after themselves, is forecast to quadruple by 2050 in developing countries.
  + Effective, community-level primary health care for older people is crucial.
  + Supportive, "age-friendly" environments enable older people to live fuller lives, and maximize the contribution they make.
    - Creating "age-friendly" physical and social environments can have a big impact on improving the active participation and independence of older people.
  + Healthy aging starts with healthy behaviors in earlier stages of life.
  + We need to reinvent our assumptions of old age.
    - Society needs to break stereotypes and develop new models of aging for the 21st century. Everyone benefits from communities, workplaces, and societies that encourage active and visible participation of older people.

**3.4.15 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research-3)

**3.4.15.1 References on Aging**[**§**](http://www.w3.org/TR/coga-user-research/#references-on-aging)

* World Health Organization: On Aging: <http://www.who.int/topics/ageing/en/>.
* W3C Developing Websites for Older People: How WCAG 2.0 Applies: <http://www.w3.org/WAI/older-users/developing>.

**3.4.15.2 References on Dementia**[**§**](http://www.w3.org/TR/coga-user-research/#references-on-dementia)

* UK: Alzheimer's Society: <http://www.alzheimers.org.uk/site/index.php>.
  + 2013 Study: (Text Only Version) <http://www.alzheimers.org.uk/site/scripts/documents_info.php?documentID=2164>.
* UK: Dementia Voices: <http://dementiavoices.org.uk/>.
  + Designing Websites for People with Dementia: <http://dementiavoices.org.uk/wp-content/uploads/2013/11/DEEP-Guide-Creating-websites.pdf>.

**3.4.15.2.1 References on Alzheimer's**[**§**](http://www.w3.org/TR/coga-user-research/#references-on-alzheimer-s)

* US: Alzheimer's Association: <http://www.alz.org/>.
* UK: Alzheimer's Society: <http://www.alzheimers.org.uk/site/index.php>.
* US: Where Alzheimer's Starts and How It Spreads (ScienceDaily Research News): <http://www.sciencedaily.com/releases/2013/12/131222160018.htm>.
* US: National Institute on Aging - Alzheimer's Disease Fact Sheet: <http://www.nia.nih.gov/alzheimers/publication/alzheimers-disease-fact-sheet>.
* Argentina: Eye movement when reading could be early indicator of Alzheimer's: <http://www.sciencedaily.com/releases/2014/03/140326114514.htm>.

**3.4.15.2.2 References on Less-Common Dementia (Non-Alzheimer's)[§](http://www.w3.org/TR/coga-user-research/" \l "references-on-less-common-dementia-non-alzheimer-s" \o "Permalink for references-on-less-common-dementia-non-alzheimer-s)**

Less-Common Dementia (Non-Alzheimer's)

(1) (<http://alzheimers.org.uk/site/scripts/documents_info.php?documentID=159>) (2) Alzheimer's Society International (3) Alzheimer's disease International (2010). 'World Alzheimer Report 2010.' London: Alzheimer's disease International. (4) Alzheimer's Society - 'Short changed: Protecting people with dementia from financial abuse'. Alzheimer's Society undertook the largest ever survey carried out on this subject; and analyzed responses from 104 carers and 47 people with dementia; as well as focus groups and interviews with professionals. (5) EuroCoDe, 2006-2008 (6) <http://www.ncbi.nlm.nih.gov/pubmed/19811879> (7) Fabian, D. & Flatt, T. (2011) The Evolution of Aging. (8) www.senescence.info - Joao Pedro de Maglahaes (9) <http://www.who.int/mediacentre/factsheets/fs362/en/>.

**3.4.15.3 References from literature reviews on Dementia and ICT from Peter Cudd**[**§**](http://www.w3.org/TR/coga-user-research/#references-from-literature-reviews-on-dementia-and-ict-from-peter-cudd)

INDIVUI

How Individual Should Digital AT User Interfaces Be for People with Dementia. Peter Cudd, Philippa Greasley, Zoe Gallant, Emily Bolton and Gail Mountain. AAATE proceedings 3012.

**Abstract.** A literature review of papers that have explored digital-technology. user-interface design for people with dementia is reported. Only papers that have employed target user input directly, or from other works, have been included. Twenty four were analyzed. Improvements in reporting of studies are recommended. A case is made for considering the population of people with dementia as so heterogeneous that one design does not suit all. This is illustrated through some case-study reports from people with dementia. Furthermore, it is proposed that, by grouping people into functionally-similar sub-groups, interfaces may be designed for these groups that will collectively establish a sequence of 'stepping stone' interfaces that better address appropriate functioning and maintain self-efficacy. Fundamentally, people living with dementia are unique individuals with unique specific needs. A priori, in life experiences, interests, willingness to learn, environmental factors, and co-morbidities, they are as varied as any of their age peers. One thing they do not share with those peers is the degenerative consequences of the specific dementia they have. The progression of their disease also follows a unique time line, even if the general symptoms (and thus perhaps functional ability) change in a fairly predictable order. In the face of these statements, it might be inferred that it is most likely people with dementia require individual but adaptive (to progression of the disease), bespoke solutions for sustained independent living.

Given the breadth of individuality in people, the effects of dementias, and indeed their progression, it is impossible to view them as a single, homogeneous population in terms of specifying a single user interface. In consequence, rather than simply designing for all people living with dementia, it is suggested that design for populations at stages of functional ability be investigated. Methods that set out to identify shared and bespoke requirements are needed to systematically establish any generalization. Currently, studies on design of digital AT, and indeed other ICT for people living with dementia, need to report much-more detail on: describing their participants; details of user interface features that worked well; and how much and what form carers' help took. More attention also needs to compare strategies and features that work to identify those that are best; or at least best for specific functional ability or tasks.

**3.4.15.3.1 Key refs (as indicated by title)[§](http://www.w3.org/TR/coga-user-research/" \l "key-refs-as-indicated-by-title" \o "Permalink for key-refs-as-indicated-by-title)**

[INDIVUI\_10]

Making software accessible to people with severe memory deficits. N. Alm, R. Dye, A. Astell, M. Ellis, G. Gowans, J. Campbell. Proceedings of Accessible Design in the digital world, Dundee, 23-25 August 2005.

[INDIVUI\_12]

Developing smart phone applications for people with Alzheimer's disease. N. Armstrong, C.D. Nugent, G. Moore, D.D Finlay. Proceedings of the IEEE/EMBS Region 8 International Conference on Information Technology Applications in Biomedicine, ITAB. 2010.

[INDIVUI\_13]

Working with people with dementia to develop technology: The CIRCA and Living in the Moment projects. A.J. Astell, N. Alm, G. Gowans, M.P. Ellis, P. Vaughan, R. Dye, J. Campbell. Journal of Dementia Care, 17, 1. 2009, 36-39.

[INDIVUI\_25]

Functional requirements for assistive technology for people with cognitive impairments and dementia F.J.M. Meiland, M.E. De Boer, J. Van Hoof, J. Van Der Leeuw, L. De Witte, M. Blom, R.M. Dröes. Communications in Computer and Information Science 277 CCIS. 2012, 146-151.

[INDIVUI\_26]

Video reminders as cognitive prosthetics for people with dementia. S.A. O'Neill, S. Mason, G. Parente, M.P. Donnelly, C.D. Nugent, S. McClean, D. Craig. Ageing International36(2). 2011, 267-282.

[INDIVUI\_27]

Designing technology to improve quality of life for people with dementia: User-led approaches. R. Orpwood, J. Chadd, D. Howcroft, A. Sixsmith, J. Torrington, G. Gibson, G. Chalfont. Universal Access in the Information Society9(3). 2010, 249-259.

[INDIVUI\_14]

"Living in the Moment": Developing an interactive multimedia activity system for elderly people with dementia. A.J. Astell, M.P. Ellis, N. Alm, R. Dye, G. Gowans, P. Vaughn, Proceedings of the International Workshop on Cognitive Prostheses and Assisted Communication. 2006, 16-20.

[INDIVUI\_17]

A user driven approach to develop a cognitive prosthetic to address the unmet needs of people with mild dementia. R.J. Davies, C.D. Nugent, M.P. Donnelly, M. Hettinga, F.J. Meiland, F. Moelaert, R. Dröes. Pervasive and Mobile Computing, 5(3) 2009, 253-267.

[INDIVUI\_19]

Usable User Interfaces for Persons with Memory Impairments. R. Hellman. Advanced Technologies and Societal Change. 2012, 167-176.

[INDIVUI\_20]

Requirements guideline of assistive technology for people suffering from dementia. J. Hyry, G. Yamamoto, P. Pulli. ACM International Conference Proceeding Series. ISABEL '11 Proceedings of the 4th International Symposium on Applied Sciences in Biomedical and Communication Technologies, Article No. 39. 2011.

[INDIVUI\_21]

The challenge of coming to terms with the use of a new digital assistive device: A case study of two persons with mild dementia. E. Karlsson, K. Axelsson, K. Zingmark, S. Sävenstedt. Open Nursing Journal5. 2011, 102-110.

[INDIVUI\_23]

Usability of tablet computers by people with early-stage dementia. F.S. Lim, T. Wallace, M.A. Luszcz, K.J. Reynolds. Gerontology, 59. 2013, 174-182.

[INDIVUI\_24]

User needs and user requirements of people with dementia: Multimedia application for entertainment. O. Maki, P. Topo. In: P. Topo and B. Ostlund (eds). Dementia, Design and Technology. Assistive Technology Research Series Vol. 24. IOS Press: Amsterdam. 2009.

[INDIVUI\_30]

Accessible websites for people with dementia: A preliminary investigation into information architecture. N. Savitch, P. Zaphiris. Lecture Notes in Computer Science (including sub-series Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 4061 LNCS. 2006, 144-151.

[INDIVUI\_32]

Designing ICT for the over 80s. E.L. Waterworth, J.A. Waterworth. In: P. Topo and B. Ostlund (eds). Dementia, Design and Technology. Assistive Technology Research Series Vol. 24. IOS Press : Amsterdam. 2009.

[INDIVUI\_33]

Maavis : "Touchscreen computer helps care home residents keep in touch with family", British Journal of Healthcare Computing, 2010, available at http://www.bjhc.co.uk/archive/news/2010/n1010032.htm; Accessed on 26/03/13.

**3.4.15.3.2 Others**[**§**](http://www.w3.org/TR/coga-user-research/#others)

[INDIVUI\_2]

Technology studies to meet the needs of people with dementia and their caregivers: A literature review. P. Topo. Journal of Applied Gerontology28(1). 2009, 5-37.

[INDIVUI\_4]

The potential of information and communication technologies to support ageing and independent living. J. Soar. Annals of Telecommunications- Annales Des Telecommunications, 65 (9-10). 2010, 479-483.

[INDIVUI\_9]

An interactive entertainment system usable by elderly people with dementia. N. Alm, A. Astell, G. Gowans, R. Dye, M. Ellis, P. Vaughan, A.F. Newell. Lecture Notes in Computer Science (including sub-series Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 4555 LNCS (PART 2). 2007, 617-623.

[INDIVUI\_11]

A communication support system for older people with dementia. N. Alm, R. Dye, G. Gowans, J. Campbell, ,A. Astell, M. Ellis. IEEE Computer40No 5. 2007, 35-41.

[INDIVUI\_16]

First steps in designing a videophone for people with dementia: Identification of users' potentials and the requirements of communication technology. I. Boman, L. Rosenberg, S. Lundberg, L. Nygård. Disability and Rehabilitation: Assistive Technology, 7(5) 2012, 356-363.

[INDIVUI\_18]

A mobile multimedia technology to aid those with alzheimer's disease. M. Donnelly, C. Nugent, S. McClean, B. Scotney, S. Mason, P. Passmore, D. Craig. IEEE Multimedia, 17(2). 2010, 42-51.

[INDIVUI\_22]

Memory aid to structure and support daily activities for people with dementia. Y. Kerkhof, F. Rabiee, C.G. Willems. Assistive Technology Research Series29. 2011, 3-9.

LANG

Language and Communication in the Dementias: Implications for User Interface Design. Philippa Greasley and Peter Cudd. AAATE proceedings. 2013.

**Abstract.** The design of user interfaces for people with dementia does not appear, from the literature, to take into account the concomitant language and communication deficits when choosing the language used in the interfaces. A systematic approach was used to search databases for studies relating to language and communication in the four most-common forms of dementia (Alzheimer's disease, vascular dementia, fronto-temporal dementia and dementia with Lewy bodies). Studies identified were used as a basis for the commentary in this paper. Communication deficits are common in dementia. From the earliest stages of the disease, the person with dementia's capacity for communication declines as difficulties emerge with all aspects of language and functional communication. These deficits have implications for the successful interaction with assistive digital technology designed to improve the quality of life of people with dementia. More consideration should be given at the design stages to the potential impact of communication difficulties on interaction with technology.

It is important to note that the authors have not been able to find, to date, any conclusions about what impact these impairments may have on user interface design.

The results of this review have highlighted areas of strength (reading) and areas of difficulty (spoken-language output and understanding some aspects of spoken and written language) in the communication abilities of people living with dementia. Those who design interfaces for this client group should consider the impact that their language and communication choices might have on end-users with dementia. In particular, the following general guidelines should be taken into account, in order to maximize the accessibility of the language of interfaces for people with dementia.

**3.4.15.3.3 Key refs (by title)[§](http://www.w3.org/TR/coga-user-research/" \l "key-refs-by-title" \o "Permalink for key-refs-by-title)**

[LANG\_3]

Review of ICT-based services for identified unmet needs in people with dementia. S. Lauriks, A. Reinersmann, H.G. Van der Roest, F.J.M. Meiland, R.J. Davies, F., Moelaert, R. M. Dröes. Ageing Research Reviews, 6(3), 200) 223-246.

[LANG\_6]

Functional requirements for assistive technology for people with cognitive impairments and dementia. F.J.M. Meiland, M.E. De Boer, J. Van Hoof, J. Van Der Leeuw, L. De Witte, M. Blom, R.M Dröes. Communications in Computer and Information Science 277 CCIS, 2012, 146-151.

[LANG\_8]

Designing an interface usable by people with dementia. N. Alm, R. Dye, G. Gowans, J. Campbell, A. Astell, and M. Ellis. In Proceedings of the 2003 conference on Universal usability (CUU '03).ACM, New York, NY, USA, 2002 156-157.

[LANG\_11]

ICT Interface Design for Ageing People and People with Dementia. J. Wallace, M. D. Mulvenna, S. Martin, S. Stephens, W. Burns. In: M. D. Mulvenna & C. D. Nugent (eds). Supporting People with Dementia Using Pervasive Health Technologies, London: Springer-Verlag. 2010.

**3.5 Down Syndrome[§](http://www.w3.org/TR/coga-user-research/" \l "down-syndrome" \o "Permalink for down-syndrome)**

**Down syndrome** also known as **Trisomy 21**, is a genetic disorder caused by the presence of all or part of a third copy of [chromosome 21](http://en.wikipedia.org/wiki/Chromosome_21_%28human%29). It is typically associated with [physical-growth](http://en.wikipedia.org/wiki/Child_development) delays, characteristic [facial features](http://en.wikipedia.org/wiki/Dysmorphic_feature), and mild to moderate [intellectual disability](http://en.wikipedia.org/wiki/Intellectual_disability).

Education and proper care has been shown to improve [quality of life](http://en.wikipedia.org/wiki/Quality_of_life). Some children with Down syndrome are educated in typical-school classes, while others require more-specialized education. Some individuals with Down syndrome graduate from high school, and a few attend [post-secondary education](http://en.wikipedia.org/wiki/Post-secondary_education).

Down syndrome is best known for its effect on the development of literacy and language-related skills. Down syndrome is widely recognized as being a specific learning disability of neurological origin, which does not imply low intelligence or poor educational potential, and which is independent of race and social background.

**3.5.1 Cognitive functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-5)

This section is a technical reference. Jump to the next section on [Symptoms](https://www.w3.org/WAI/PF/cognitive-a11y-tf/wiki/Gap_Analysis/ds#Symptoms) for more practical information.

**3.5.1.1 Overview**[**§**](http://www.w3.org/TR/coga-user-research/#overview)

Improvements in medical interventions for people with Down syndrome have led to a substantial increase in their life longevity. Diagnosis and treatment of neurological complications are important in maintaining optimal cognitive functioning.

The cognitive phenotype in Down syndrome is characterized by impairments in morphosyntax, verbal short-term memory, and explicit long-term memory. However, visuospatial short-term memory, associative learning, and implicit long-term memory functions are preserved. Seizures are associated with cognitive decline. They seem to cause additional decline in cognitive functioning, particularly in people with Down syndrome and comorbid disorders, such as autism. Vision and hearing disorders, as well as hypothyroidism, can have a negative impact onn cognitive functioning in people with Down syndrome.

Dementia that resembles Alzheimer's disease is common in adults with Down syndrome. Early-onset dementia in adults with Down syndrome does not seem to be associated with atherosclerotic complications.

Source: The Lancet

**3.5.1.2 Auditory Discrimination**[**§**](http://www.w3.org/TR/coga-user-research/#auditory-discrimination-2)

People with Down syndrome often struggle with short-term auditory memory. Most people use memory to process, hold, understand, and assimilate spoken language. Auditory memory relates directly to the speed with which words can be articulated, and influences the speed at which people learn new words and learn to read.

Theories about memory suggest words that are heard are received and stored in working memory to make sense of them. They are then transferred to a more long-term store. However, words are only retained in the working memory for two seconds unless consciously kept there by silently repeating them to oneself, called rehearsing. The amount of information that can be retained within the two-second span is called the auditory digit span.

Is there a relationship between Down syndrome and working memory?

Yes, many people with Down syndrome have difficulties in this area. Generally, long-term memory is not impaired. Neither is the visual memory, which is often far stronger.

Source: Sandy Alton

**3.5.1.3 Visual-Recognition Skills**[**§**](http://www.w3.org/TR/coga-user-research/#visual-recognition-skills-3)

The cognitive profile observed in Down syndrome is typically uneven, with stronger visual than verbal skills; receptive vocabulary stronger than expressive language and grammatical skills; and often strengths in reading abilities. There is considerable variation across the population of people with Down syndrome.

Many studies have included typically-developing children matched for chronological age, for non-verbal mental age, or on a measure of language or reading ability. Individuals with Down syndrome have also been compared to individuals with learning difficulties of an unknown origin, and to individuals who have learning difficulties of a different aetiology (e.g., specific-language impairment).

The particular measures of language, reading, or non-verbal ability, used for matching, can affect the conclusion drawn. There are also behavioral aspects of the Down syndrome phenotype other than non-verbal ability and language ability (such as motivational style), which may affect performance on tasks, including attainment tests, and need to be taken into account.

In terms of education, there is strong evidence to suggest that the relatively-recent policy of educating children with Down syndrome in mainstream schools has had a positive effect on language skills and academic attainments. This means that the findings of studies conducted a number of years ago need to be interpreted with caution.

Source: Margaret Snowling, Hannah Nash, and Lisa Henderson

**3.5.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-4)

Intellectual and cognitive impairment, and problems with thinking and learning, usually range from mild to moderate. Common symptoms are:

* short attention span;
* poor judgment;
* impulsive behavior;
* slow learning;
* delayed language and speech development;
* reading is typically slow and laborious. (If people are undiagnosed or diagnosed late, they may be illiterate or barely literate.);
* concentration tends to fluctuate;
* poor and unusual spelling and grammar;
* handwriting is unusable or very messy;
* poor physical coordination;
* difficulty remembering information (tends to fluctuate);
* difficulty with organizing and planning;
* difficulty working within time limits;
* difficulty thinking and working in sequences, which can make planning difficult;
* visual processing difficulties, which can affect reading and recognizing places;
* poor auditory processing skills;
* listening to oral instructions difficult, tiring and confusing.

Symptoms vary with each person, and appear at different times in their lives.

Source: NIH

**3.5.3 Their Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#their-challenges)

**3.5.3.1 Memory**[**§**](http://www.w3.org/TR/coga-user-research/#memory-1)

* Poor short term memory for facts, events, times, dates, symbols.
* Poor working memory; i.e., difficulty holding on to several pieces of information at the same time. This is especially challenging while undertaking a task, e.g., taking notes while listening, addressing compound questions.
* Mistakes with routine information, e.g., providing age, phone number, or ages of children.
* Inability to hold on to information without referring to notes.

**3.5.3.2 Automatizing skills**[**§**](http://www.w3.org/TR/coga-user-research/#automatizing-skills-1)

People with Down syndrome do not tend to automatize skills very well. A high degree of mental effort is required to carry out tasks that other individuals generally do not feel requires effort. This is particularly true when the skill is composed of several sub-skills (e.g., reading and writing).

**3.5.3.3 Information Processing**[**§**](http://www.w3.org/TR/coga-user-research/#information-processing)

* Difficulties with taking in information efficiently (this could be written or auditory).
* Slow speed of information processing, such as a 'penny dropping' delay between hearing or reading something; and understanding and responding to it.

**3.5.3.4 Communication Skills**[**§**](http://www.w3.org/TR/coga-user-research/#communication-skills-1)

* Lack of verbal fluency and lack of precision in speech (relevant for voice systems).
* Word-finding problems.
* Inability to work out what to say quickly enough.
* Misunderstandings or misinterpretations during oral exchanges.
* Sometimes mispronunciations or a speech impediment may be evident.

**3.5.3.5 Literacy**[**§**](http://www.w3.org/TR/coga-user-research/#literacy-1)

* Difficulty in acquiring reading and writing skills. Reading is likely to be slow.
* If people are undiagnosed or diagnosed late, they may be illiterate or barely literate.
* Where literacy has been mastered, problems continue, such as poor spelling; difficulty extracting meaning from written material; difficulty with unfamiliar words; and difficulty with scanning or skimming text.
* Particular difficulty with unfamiliar or new language, such as jargon.

**3.5.3.6 Organization, Sequencing**[**§**](http://www.w3.org/TR/coga-user-research/#organization-sequencing-1)

* Difficulty organizing a sequence of events.
* Incorrect sequencing of strings of numbers and letters. (passwords, phone numbers)
* Chronic disorganization and misplacing/losing items.
* Difficulty with time management and passage of time.

**3.5.3.7 Navigation**[**§**](http://www.w3.org/TR/coga-user-research/#navigation-1)

* Difficulty with finding the way to places or navigating, even within a building. Often get lost.

**3.5.3.8 Sensory Sensitivity**[**§**](http://www.w3.org/TR/coga-user-research/#sensory-sensitivity-1)

* Sensitivity to noise and visual stimuli.
* Impaired ability to screen out background noise / movement.
* Sensations of mental overload.
* Tendency to "switch off".

**3.5.3.9 Lack of Awareness**[**§**](http://www.w3.org/TR/coga-user-research/#lack-of-awareness-1)

* Failure to notice body language.
* Failure to realize the consequences of their speech or actions.

**3.5.3.10 Visual Stress**[**§**](http://www.w3.org/TR/coga-user-research/#visual-stress-1)

* Some people may experience visual stress when reading, especially when dealing with large amounts of text. Breaks are often needed.

**3.5.3.11 Coping Strategies**[**§**](http://www.w3.org/TR/coga-user-research/#coping-strategies-1)

It must be emphasized that individuals vary greatly in their Specific Learning Difficulties profile. Key variables are the severity of the difficulties; the ability of individuals to identify and understand their difficulties; and successfully develop and implement coping strategies.

By adulthood, many people with Specific Learning Difficulties are able to compensate through technology, reliance on others, and an array of self-help mechanisms, the operation of which requires sustained effort and energy. Unfortunately, these strategies are prone to break down under stressful conditions, which impinge on areas of weakness.

**3.5.3.12 Effects of Stress**[**§**](http://www.w3.org/TR/coga-user-research/#effects-of-stress-1)

People are particularly susceptible to stress (compared with the typical population), resulting in an increase of their impairments.

**3.5.4 Some Personas with Use Cases That Address Key Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#some-personas-with-use-cases-that-address-key-challenges)

**3.5.4.1 Scenario A is a high school student with Down syndrome.**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-a-is-a-high-school-student-with-down-syndrome.x)

Although she can read at a 3rd grade level, reading is slow and difficult. Books geared towards a younger audience with a lot of pictures help. Plus, she can comprehend and remember stories read by others. Test taking is very stressful, It helps when the teacher can help her take the test orally. She is strong on the computer, especially when interested in the topics. She can surf the Web and do research, but needs to be reminded to stay on task and not get distracted by other sites and advertisements. She does not use assistive technology, but has in the past to improve her reading skills. The teacher aide has to remind her to stay on task during exercises. She can do simple research projects, but only if supported with reminders and visual ques.

|  |  |
| --- | --- |
| Table of ICT Steps and Challenges | |
| **Step** | **Challenge** |
| Search query |  |
| Scanning results |  |
| Doing a short review of different options and finding the most appropriate. |  |
| Finding the right content in the right document. |  |
| Read the right content. |  |
| Collecting the information. |  |
| Coping with citing resources and collecting them with the right information. |  |
| Remembering the process (re-finding it next time). |  |
| Saving the work. |  |
| Putting it together and writing the paper. | Her writing is poor, so this would be out of scope for this use case. |

**3.5.5 How They Use the Web and ICT to Include: Email, Apps, Voice-systems, IM**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict-to-include-email-apps-voice-systems-im)

Add table.

**3.5.6 How People with Cognitive Disabilities Use Optimized Content and Special Pages**[**§**](http://www.w3.org/TR/coga-user-research/#how-people-with-cognitive-disabilities-use-optimized-content-and-special-pages)

Add examples with descriptions of features.

**3.5.7 Characteristics of Content Optimized for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-3)

Add descriptions of key features and how it helps users overcome challenges.

**3.5.8 Specific technologies (reference section below and how they use it differently).**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies-reference-section-below-and-how-they-use-it-differently-.x)

Add section.

**3.5.9 Summary of Existing Research and Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines-2)

Aim to ensure that written material takes into account the visual stress experienced by some people with Down syndrome, and facilitates ease of reading. Adopting best practice for readers with Down syndrome has the advantage of making documents easier on the eye for everyone. Font. (Remember people with Down syndrome can be easily distracted and confused.)

* Use a plain, evenly-spaced, sans-serif font, such as Arial and Comic Sans. Alternatives include Verdana, Tahoma, Century Gothic, Trebuchet.
* Font size should be 12-14 point. Some people with Down syndrome may request a larger font.
* Use dark-colored text on a light (not white) background.

**3.5.9.1 Headings and Emphasis**[**§**](http://www.w3.org/TR/coga-user-research/#headings-and-emphasis-1)

* Avoid underlining and italics. These tend to make the text appear to run together. Use bold instead.
* AVOID TEXT IN BLOCK CAPITALS. This is much harder to read.
* For headings, use larger font sizes in bold, lower case.
* USe boxes and borders for effective emphasis.

**3.5.9.2 Layout**[**§**](http://www.w3.org/TR/coga-user-research/#layout-1)

* Use left-justified text with a ragged right edge.
* Avoid narrow columns (as used in newspapers).
* Use lines that are not too long: 60 to70 characters.
* Avoid cramping material and using long, dense paragraphs. Space it out.
* Use line spacing of 1.5.
* Avoid starting a sentence at the end of a line.
* Use bullet points and numbering rather than continuous prose.

**3.5.9.3 Writing Style**[**§**](http://www.w3.org/TR/coga-user-research/#writing-style-1)

* Use short, simple sentences in a direct style.
* Give instructions clearly. Avoid long sentences of explanation.
* Use active rather than passive voice.
* Avoid double negatives.
* Be concise.

**3.5.9.4 Increasing Accessibility**[**§**](http://www.w3.org/TR/coga-user-research/#increasing-accessibility-1)

* Flow charts are ideal for explaining procedures.
* Pictograms and graphics help to locate information.
* Lists of 'do's and 'don't's' are more useful than continuous text to highlight aspects of good practice.
* Avoid abbreviations if possible; or provide a glossary of abbreviations and jargon.
* For long documents, include a contents page at the beginning and an index at the end.

Note: The spell checker in MS Word can be set to automatically check readability. MS Word will then show the readability score every time spelling is checked.

* Check long documents in sections to determine which parts are too hard to read.
* Flesch Reading Ease score: Rates text on a 100-point scale. The higher the score, the easier it is to understand the document. For most standard documents, aim for a score of approximately 70 to 80.
* Flesch-Kincaid Grade Level score: Rates text on a U.S. grade-school level. For example, a score of 5.0 means that a fifth grader, i.e., a Year 6, average 10 years old, can understand the document. For most standard documents, aim for a score of approximately 5.0 by using short sentences, not by simplifying vocabulary.

References:

* BBC: My web, my way. Making the web easier to use: <http://www.bbc.co.uk/accessibility/guides/allguides_index.shtml>.

**3.5.10 Extent To Which Current Needs Are Met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-4)

Review challenges and describe where needs are met. Identify gaps.

**3.5.11 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-3)

Add ideas for filling gaps.

**3.5.12 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-4)

The estimated incidence of Down syndrome is between 1 in 1,000 to 1 in 1,100 live births worldwide. Each year, approximately 3,000 to 5,000 children are born with this chromosome disorder. It is believed there are about 250,000 families in the United States of America who are affected by Down syndrome.

Sixty to 80 percent of children with Down syndrome have hearing deficits. Forty to 45 percent of children with Down syndrome have congenital heart disease. Intestinal abnormalities also occur at a higher frequency in children with Down syndrome.

Children with Down syndrome often have more eye problems than other children who do not have this chromosome disorder. Another concern relates to nutritional aspects. Some children with Down syndrome, in particular those with severe heart disease, often fail to thrive in infancy. On the other hand, obesity is often noted during adolescence and early adulthood. These conditions can be prevented by providing appropriate-nutritional counseling and anticipatory-dietary guidance.

Thyroid dysfunctions are more common in children with Down syndrome than in other children. Skeletal problems have also been noted at a higher frequency in children with Down syndrome. Other important medical aspects in Down syndrome, including immunologic concerns, leukemia, Alzheimer disease, seizure disorders, sleep apnea, and skin disorders, may require the attention of specialists in their respective fields.

Source: World Health Organization - <http://www.who.int/genomics/public/geneticdiseases/en/index1.html>.

**References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-4)

Add section.

**3.6 Description**[**§**](http://www.w3.org/TR/coga-user-research/#description)

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder affecting both children and adults. It is characterized by some persistent (lasting at least 6 months) symptoms of hyperactivity, impulsivity, and/or inattention that have a significant impact on daily life or typical development. For a diagnosis of ADHD, symptoms must frequently occur in more than one environment (e.g., in work and at home), and must not be appropriate for the age of the individual. The symptoms should also cause social, educational, or work-related issues (American Psychiatric Association, 2013).

Review of the available literature suggests that ADHD is not viewed as a single impairment / disease entity, but people with ADHD can be considered as a heterogeneous group of individuals defined by a series of behavioral symptoms. The symptoms presented vary in type and intensity between individuals with ADHD, and may vary in type and intensity with time for a given individual.

**3.6.1 Cognitive functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-6)

No single cognitive impairment characterizes people with ADHD (American Psychiatric Association, 2013). Cognitive impairments, although secondary, feature in the diagnosis of ADHD (American Psychiatric Association, 2013); and are vital in determining the learning and cognitive needs of people with ADHD.

Studies have suggested that children with ADHD exhibit multiple deficits in working memory, related to spatial storage and spatial executive functioning, which are independent of any language-learning disorders presented by the same individual (Martinussen, et al., 2005). It has also been suggested that dysfunctional, neurological, parallel-processing pathways are a potential partial explanation of executive-dysfunction association with ADHD, but further research on cognition from a neurophysiological and developmental point of view are required to confirm this (Castellanos, et al., 2006).

Cognitive impairments associated with ADHD include (Nigg, 2009):

* issues with executive functioning;
* reading learning disabilities;
* math disabilities;
* handwriting disabilities;
* non-verbal learning disabilities;
* diminished visual-processing speeds not related to inattention (Weiler, et. al., 2002);
* developmental coordination disorder / motor clumsiness -Motor clumsiness may be less prevalent in older children (9 years and older), teenagers, and adults with ADHD (Meyer & Sagvolden, 2006).

Context-dependent cognitive effects associated with ADHD include issues with (Nigg, 2009):

* slow, careful behavior;
* fast, accurate behavior;
* rapid-decision making;
* planning, and short-term recall;
* reward cues;
* time estimation.

It is unclear if any of these context-dependent cognitive effects are unique to ADHD. However, evidence suggests they are not explained by co-occurring problems and, in most instances, are more-clearly associated with ADHD (the issue being more pronounced) than with other disorders exhibiting the same issues (Willcutt, et al., 2008).

Comorbidity with learning disabilities is common in people with ADHD. The literature reviewed shows a wide variance of the incidence of people with ADHD that also present with learning disabilities of between 20% and 60% (Czamara, et al., 2013). This highly-variable overlap has been previously attributed to inconsistencies in the definition of learning disabilities, and a general over identification of learning disabilities (Semrud-Clikeman, et. al., 1992). However, comorbidity with reading disorder (Germanò, et. al., 2010), dyslexia, dyspraxia (Pauc, 2005), and dyscalculia (Lindsay, et. al., 2001) have all been reported, although the underlying functional processes remain unclear (Czamara, et. al., 2013).

Comorbidity with behavioral disabilities (such as oppositional-defiant disorder and developmental-coordination disorder) has been shown to be extremely high (>70%) amongst young children (Kadesjö & Gillberg, 2001), suggesting that ADHD without comorbidity is atypical in children with ADHD.

**3.6.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-5)

The most commonly used diagnosis of ADHD follows the guidelines outlined by the American Psychiatric Association (2013), and will be followed here. Three presentations (formerly called subtypes) of ADHD are recognized:

1. Predominantly Inattentive ADHD
2. Predominantly Hyperactive-Impulsive ADHD
3. Combined ADHD

**3.6.2.1 Predominantly Inattentive ADHD - symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#predominantly-inattentive-adhd---symptoms)

Symptoms associated with Predominantly Inattentive ADHD include:

* failing to pay close attention to detail or making careless mistakes;
* having difficulty sustaining attention;
* not appearing to listen;
* struggling to follow instructions to completion;
* difficulty with organization;
* avoiding or disliking tasks requiring a lot of thinking;
* losing things;
* being easily distracted;
* being forgetful in daily activities.

**3.6.2.2 Predominantly Hyperactive-Impulsive ADHD – symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#predominantly-hyperactive-impulsive-adhd-symptoms)

Symptoms associated with Predominantly Hyperactive-Impulsive ADHD include:

* fidgeting with hands or feet or squirming in chairs;
* having difficulty remaining seated;
* running around or climbing excessively (in children), extreme restlessness (in adults);
* difficulty engaging in activities quietly;
* acting as if driven by a motor (adults will often feel inside like they were driven by a motor);
* talking excessively;
* calling out answers before questions have been completed;
* difficulty in waiting or in taking turns;
* interrupting or intruding upon others.

**3.6.2.3 Diagnosis of ADHD**[**§**](http://www.w3.org/TR/coga-user-research/#diagnosis-of-adhd)

To be diagnosed with ADHD using the above symptoms, a child should exhibit at least 6 of the symptoms. A late-teen or an adult should exhibit at least 5. The ADHD presentation exhibited depends upon the predominance of the symptoms, being: mostly-inattentive symptoms; mostly hyperactive-impulsive symptoms; or a relatively-equal mix of symptom types, resulting in Predominantly Inattentive ADHD, Predominantly Hyperactive-Impulsive ADHD, or Combined ADHD respectively.

ADHD presentations can be subdivided into mild, moderate, or severe depending upon both the number of symptoms exhibited, and the impact the symptoms have on the individual’s daily life. Presentations are not fixed. They can change throughout the lifetime of a person with ADHD, as can the severity of the individual symptoms.

**3.6.3 Their challenges**[**§**](http://www.w3.org/TR/coga-user-research/#their-challenges-1)

Challenges for people with ADHD are dependent upon their presentation of ADHD and the symptoms associated with the individual. Due to the high incidence of comorbidity with learning disabilities, it is difficult to identify challenges that are unique to people with ADHD. As noted above, the number and the severity of the symptoms associated with a particular presentation of ADHD can vary with time (Centers for Disease Control and Prevention, 2014a). A result of this is that the challenges for a person with ADHD can also vary in type and intensity as the individual ages. In general terms, the challenges associated with ADHD, highlighted by Nigg (2009), include the following.

* **Issues with speed and attention to detail:** Tasks are often completed with excessive speed (Hyperactive-Impulsive), or excessively slowly due to lack of interest (Inattentive). In both cases, these behaviors are associated with inaccuracy.
* **Issues with rapid-decision making:** The ability to interrupt their responses often results in answers being blurted out and talking out of turn during meetings.
* **Executive Functioning and Working Memory:** The inability to follow instructions to their conclusion is common, especially when the instructions are presented in list form. This challenge can also extend to tasks that involve ordered steps, such as complex-arithmetical operations, or equation solving. Issues with working memory are often exhibited as forgetfulness.
* **Social Issues:** In addition to difficulty interpreting social subtexts, momentary lapses in attention are common. This can often result in missing important details if they are not repeated. Children with ADHD often have difficulty estimating the value of social contact, and consistently underrating the rewards associated with social contact when compared to control groups (Demurie, et. al., 2011).
* **Self-worth Issues:** Anecdotal evidence from teachers and parents suggest that children with ADHD exhibit low self-esteem and lack of confidence. This may be a result of peer rejection, due to actions by a person with ADHD being considered inappropriate. Self-worth issues can result in tasks being abandoned earlier than would be the case with a control group, and a perceived lack of commitment to group and/or team activities.

**3.6.4 Some persona with use case that address key challenges**[**§**](http://www.w3.org/TR/coga-user-research/#some-persona-with-use-case-that-address-key-challenges)

**3.6.4.1 Buying a book online**[**§**](http://www.w3.org/TR/coga-user-research/#buying-a-book-online)

Scenario A: "Paula" has been diagnosed with ADHD presenting as predominantly inattentive. She is 19 years old, with low self-esteem, and is easily discouraged. Her attention to detail is poor, and her attention span is low. She has a tendency to forget things quickly, and to give up in frustration. She has both younger and older siblings who do not present with ADHD. She does not receive medication.

She is trying to buy a book using an online retailer, for her father, as a birthday present. Paula has never used an online retailer before. She has decided that a book on Indian Cooking would be an appropriate gift. Her father does not read books in electronic format.

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| --- | --- |
| Table of Steps and Challenges | |
| **Step** | **Challenge** |
| 1. Search for an online book retailer. | Minor challenges.  Some care must be taken when searching for a retailer. Depending upon the wording, the search may return a list of retailers of online books, rather than an online store that sells books. This can be mitigated by searching for a well-known retailer.  Auto suggestion returns meaningful results, and is relatively forgiving of typing errors. This helps mitigate any exhibited lack of attention to detail. |
| 2. Navigate the home page. | Significant challenges.  The home page of a typical retail site tends to promote multiple products. This adds a significant degree of distraction, and can result in the loss of focus on the task at hand. If the retailer sells multiple types of products, this challenge will increase markedly. There is little that can be done about this because the distracting information is an intrinsic part of the site design, and cannot be disabled by add-blocking settings.  The search features, although towards the top of the screen, are not particularly prominent. Not being able to find them quickly may leave Paula frustrated; and may increase the likelihood of her giving up and trying a different vendor. As most vendors use a similar homepage layout, she may eventually abandon the attempt completely. |
| 3. Search for books on Indian Cookery. | No significant challenges.  The search engines are relatively robust with regard to typing errors. The resulting lists, although extensive, typically do not contain suggestions for other items not directly related to the search. Any advertising, if present, is discrete. |
| 4. Select a suitable book. | Minor challenges.  Most books are available in multiple formats (hardcover, paperback, or e-formats). Care must be taken in ensuring that the correct format is chosen. The type of format selected is not always obvious.  When reviewing a book, there are often suggestions of similar books prominently presented and situated before customer reviews. This may cause distraction, and loss of focus, leading to navigation away from the page. |
| 5. Add the purchase to the shopping cart. | No significant challenges.  The call to action is standard across retail sites. The buy button is clearly displayed, and is positioned within the logical flow of the page. It will often maintain a fixed position if the page has been scrolled through. |
| 6. Create an account. | Significant challenges.  This step requires an attention to detail because e-mail addresses are typically required, and passwords created. Security requirements for passwords are not clearly explained. Often, errors are not captured until all of the information is submitted. This may present a significant challenge due to the required attention to detail, and to frustration that may result from poorly-managed error capture and correction. |
| 7. Purchasing the item. | Minor challenges.  Although the purchasing call to action is typically prominently positioned, the page itself often contains significant distractions in the form of suggestions for additional purchases. This may lead to loss of focus. This is part of the intrinsic design of the site. Little can be done to mitigate it.  The options to add gift wrapping and individual messages may not be prominently displayed. The options may not be available later in the purchasing cycle. These options can easily be overlooked. Any error checking associated with the individual message is controlled by the browser. |
| 8. Adding a delivery address. | Significant challenges.  This step may prove challenging because accuracy and attention to detail are required. Error capture and correction are minimal due to the nature of the information being captured. As the address details may be used to pre-populate a billing address at a later stage, errors at this stage may have additional impact. |
| 9. Add payment card details. | Significant challenges.  This step presents challenges because the information must be entered accurately. The error handling may not be immediate, and may return somewhat cryptic responses. This may cause Paula to give up at this point. |
| 10. Confirm purchase. | No challenges.  The successful completion of the order relies on the information provided at steps 8 and 9. While there is significant control at stage 9, if the details are incorrect, the payment will not be processed. Any errors due to lack of accuracy / attention to detail at step 8 may result in the book not being delivered to the correct address. |

**3.6.4.2 Booking train tickets online**[**§**](http://www.w3.org/TR/coga-user-research/#booking-train-tickets-online)

Scenario B: "Ian" is 34. He has been diagnosed with ADHD, presenting predominantly Hyperactive-Impulsive. He lives alone. Despite his outward appearance, social exclusion as a child has led to Ian having low self-esteem. Ian has a strong grasp of technology. He is not afraid of trying out new things.

Ian is planning a holiday in Ireland, where he has never visited. He wishes to book a return-train journey from Dublin to Galway.

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| --- | --- |
| Table of Steps and challenges | |
| **Step** | **Challenge** |
| 1. Search for online information. | No significant challenges.  Search engines are robust with respect to spelling and semi-ambiguous search terms. The highly-ranked, returned results are relevant. However, some high-ranking results attempt to plan routes, and require local geographic knowledge, which may result in some confusion. |
| 2. Select a suitable site. | Some challenges.  The sites returned are clearly labeled. The layout is clear and free of distractions. The official site of Irish Rail (<http://www.irishrail.ie/>) is close to the top of the list of returned sites, and will be used for the rest of the use challenge.  The first site returned, "Dublin Galway Fares - Irish Rail", is a beta site for a fare calculator. It is confusing to use. It requires the user to know which Dublin stations service Galway. The page contains a great deal of information that is not relevant to the task at hand. The function of the site is not clearly labeled. The information returned from a search is overwhelming. This could easily lead to loss of focus and confusion. |
| 3. Navigate the home page. | Minor challenges.  The information on the home page is relevant to finding and booking train journeys. The navigation features are clear and typical of other websites. The form fields used in finding train times and booking tickets are prominently displayed. Any additional offers and information, which are not directly relevant, are mainly located in a position that does not detract from the primary information. |
| 4. Select route. | No significant challenges.  The fields used to select the starting point and the destination are robust with regard to typing errors. No local geographic knowledge is required to make the selection, although this can be used to refine the search. Date and time fields default to a calendar for selection when the field is selected. This negates any confusion caused by date formats. |
| 5. Select journey. | Minor challenges.  Although selecting the individual parts of the journey is straightforward with the amount of information presented, it is somewhat distracting. If the legend is displayed, each item has a link to more information that is loaded, without warning, in a new browser window. This is disorienting. It has the potential to cause a loss of focus. |
| 6. Buy ticket. | No challenges.  Buying ticket opens a new secure area of the site where passenger details are added. The layout is clear. Options are kept to a minimum. The form is easy to fill in. |
| 7. Select seats. | Minor challenges.  Although the interactions on this page are fairly intuitive, there are no instructions on the usage of the page. The buttons to complete the seat selection require the user to scroll to the end of the page. This has potential to result in distraction and a loss of focus. |
| 8. Initiate account creation. | No challenges.  The page is simply laid out with clear instructions. |
| 9. Add personal details. | Significant challenges.  Most of the fields are free-form text that require accuracy and attention to detail. With the exception of the password confirmation, all error checking is done after the form is submitted. Although there is a confirmation dialog to check the address details, and messages give an indication of the error, there is a significant possibility of this step resulting in user frustration. This would likely lead to task abandonment. |
| 10. Add payment and collection details. | Significant challenges.  The page contains a number of features, which are not enabled, and which may cause confusion. Attention to detail is required when entering card details. Any errors are only returned when the form is submitted. Errors other than formatting errors, such as invalid card numbers or empty mandatory fields, are returned at step 11 rather than at this step. As step 11 is performed on a different site, manual error correction is both difficult and frustrating. This results in a likelihood of loss of focus, and / or abandonment of the task.  Two processes (payment details and delivery method) are combined on the page, which adds unnecessary complication and distraction. |
| 11. Card confirmation. | Minor challenges.  The two-step verification process, used by the card vendor, introduces a second password requirement. Accuracy and attention to detail are required to complete this step. |
| 12. Close transaction. | No challenges.  The page clearly displays the reservation number with instructions on how to collect the ticket. It is clearly communicated that this information will be sent to the e-mail address supplied during step 9. |
| A confirmation e-mail will be sent to Ian. He can use it to set up a reminder of the journey dates and times in a calendar. |  |

This site presented Ian with few challenges due to the error checking at individual key steps. It is easy to focus on the task at hand and the fact that the activities can be achieved rapidly.

**3.6.4.3 Scenario: Researching and presenting a school project**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-researching-and-presenting-a-school-project)

"Anne" is a 13 year old school student who has been diagnosed with ADHD presenting as Combined. She needs to conduct an online research project on the extinction of the dinosaurs. She is expected to consult multiple sources, which need not be academic papers. They will enable her to prepare a 15-minute PowerPoint presentation to be delivered to her class. She has one month to prepare.

[Unlike the previous scenarios, this scenario does not concentrate on the individual-processing steps, but on the overall effect of the presentation of information.]

|  |  |
| --- | --- |
| Table of Steps and Challenges | |
| **Step** | **Challenge** |
| Search for information online. | No challenges. Search engines are robust with respect to spelling and typing errors. The auto suggest returns useful results. |
| Select sites for investigation. | This step presents a significant challenge to Anne due to information overload. |

[As part of this scenario, 4 sites will be consulted. They will be assessed from Anne’s point of view as a person with ADHD.]

|  |  |
| --- | --- |
| **Step** | **Challenge** |
| Consult about.com Dinosaur extinction. <http://dinosaurs.about.com/od/dinosaurextinction/> | The site presents significant challenges to staying focused, and to relating to different parts of the article. This is due to the number of links to material unrelated to the topic in question; and to a series of advertisements that distract from the flow of information. Although the sub-pages are clearly defined with short summaries, they are not presented in a logical order. |
| Consult BBC NATURE Cretaceous-Tertiary mass extinction page. <http://www.bbc.co.uk/nature/extinction_events/Cretaceous%E2%80%93Tertiary_extinction_event> | The site presents few challenges. The information flows logically. It is clearly laid out. The content is also presented in a less-passive manner than is usual. All of the links on the page are relevant. The linked pages present a challenge with respect to navigation because they are independent articles, and because there is no bread-crumb trail. The only way to retrace steps is through the browser's back button. |
| Consult Wikipedia - Cretaceous–Paleogene extinction event. <http://en.wikipedia.org/wiki/Cretaceous%E2%80%93Paleogene_extinction_event> | The site presents challenges due to the volume of information presented, and due to the density of the text. Maintaining focus may prove challenging. |
| Consult Smithsonian National Museum of Natural History – Dinosaurs Why did they go extinct? http://paleobiology.si.edu/dinosaurs/info/everything/why.htm | The site presents significant challenges due to the volume of information, and due to the way that the text is structured. The site is designed to be navigated sequentially. This may prove a challenge to Anne. The lack of a bread-crumb trail and page titles may make orientation within the site difficult. |

**3.6.5 How they use the Web to include: email, apps, voice systems, IM.**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-to-include-email-apps-voice-systems-im.x)

There is no apparent body of evidence that people with ADHD use the web in a particular way. The prevalence of other learning disabilities presenting with ADHD makes determinations of special-usage activities, which are unique to ADHD, problematic. However, anecdotal evidence (Smith & Segal, n.d.), (Tartakovsky, 2013) suggests that the use of recurring e-mail tasks and voice mail; as well as automated reminders based on timers; are used to help people with ADHD to stay focused and "on task".

**3.6.6 How people with cognitive disabilities use optimized content and special pages**[**§**](http://www.w3.org/TR/coga-user-research/#how-people-with-cognitive-disabilities-use-optimized-content-and-special-pages-1)

There is no apparent body of evidence of special pages or content specifically-optimized to support people with ADHD.

**3.6.7 Characteristics of content optimized for this group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-4)

Before content can be optimized to support users with ADHD, further research is required into the challenges presented by ADHD that are not a result of other learning disabilities.

**3.6.8 Specific technologies**[**§**](http://www.w3.org/TR/coga-user-research/#specific-technologies-4)

There are no specific assistive technologies for people with ADHD. There are, however, several iPhone and Android Apps that have proved useful to people with ADHD (Watson, 2014). Anecdotal evidence (Cummins, 2014), (Duffy, n.d.) suggests that tools and assistive technologies, which have proven useful for adults and students with ADHD, include:

* digital pens (such as Livescribe) that help with note taking when lack of concentration may lead to main points being missed;
* word-prediction software (e.g., Co:Writer);
* screen readers;
* mind-mapping software;
* speech-recognition software;
* talking calculators (MathPad / Math talk), especially if they have timers/alarms to help students progress steadily;
* timers and to-do lists;
* using e-mail and voice mail as reminders.

All of the above tools / techniques are designed to provide support with issues around accuracy and concentration, which are common to people with ADHD.

**3.6.9 Summary Existing research and guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-existing-research-and-guidelines)

ADHD was first clearly described by George Still in 1902. It may have been partially recognized as early as the late 18th Century (Wikipedia, 2014). The symptoms associated with ADHD are listed above. The current diagnosis of the condition is defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) published by the American Psychiatric Association (American Psychiatric Association, 2013). Hyperkinetic disorders, as defined by the World Health Organization (World Health Organisation, 2014), exhibit similar symptoms to ADHD. For the purposes of providing Web support, they can be considered along with ADHD.

**3.6.9.1 Causes of ADHD**[**§**](http://www.w3.org/TR/coga-user-research/#causes-of-adhd)

The cause of the majority of ADHD cases is unclear. A number of factors may be involved in each case. Current research suggests that genetic factors are important in the development of ADHD (Centers for Disease Control and Prevention, 2014c). ADHD appears to have a very-high heritability, independent of geographic location, associated with the Latrophilin 3 gene (LPHN3) (Arcos-Burgos, et. al., 2010). ADHD is commonly inherited from one or both parents. Children with siblings are 3 to four times more likely to develop ADHD than siblings of children without the disorder. Genetic factors are also thought to determine if the condition persists into adulthood (Franke, et al., 2012). Studies of the heritability of ADHD in adult populations are much-less common than studies in children.

In cases where heredity does not seem to be a factor, difficulties during pregnancy, prenatal exposure to alcohol and tobacco, premature delivery, significantly-low birth weight, excessively-high body-lead levels, and postnatal injury to the prefrontal regions of the brain, have all been found to contribute to the risk for ADHD to varying degrees (National Resource Center on ADHD, n.d.). In addition, exposure to organophosphates may result in symptoms similar to ADHD, but the results are unclear (de Cock, et. al., 2012).

**3.6.9.2 Pathophysiology**[**§**](http://www.w3.org/TR/coga-user-research/#pathophysiology)

It is widely recognized that ADHD is a neurodevelopmental disorder associated with functional impairments in some of the neurotransmitter systems of the brain, particularly those involved in the transmission of dopamine and norepinephrine (Wikipedia, 2014).

Children and adolescents with ADHD have brains that are 3-4% smaller than those of a control group. Basic neuroimaging research is being conducted to further delineate the pathophysiology of ADHD, determine diagnostic utility of neuroimaging, and elucidate the physiological effects of treatment. However, the research is currently not definitive enough for the practical application of neuroimaging (National Resource Center on ADHD, n.d.).

**3.6.9.3 Management**[**§**](http://www.w3.org/TR/coga-user-research/#management)

The management of ADHD typically involves counseling, medication, or a combination of both. Medication typically involves the use of psychostimulants, to boost and to balance levels of neurotransmitters present in the brain, and antidepressants (Mayo Clinic, n.d.). Significant and varied side effects may be associated with medication programs for ADHD. These side effects may vary as the patient ages (Mayo Clinic, n.d.).

While treatment may reduce the effect of some of the symptoms associated with ADHD, it has not been shown to suppress all of the symptoms (Mayo Clinic, n.d.).

**3.6.9.4 Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#guidelines)

Although there are no specific guidelines produced by a governing body, there are several non-medical ways to help an individual cope with effects of ADHD with respect to ICT. These are listed in the section: Specific technologies.

**3.6.10 Extent to which current needs are met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-5)

There is no apparent body of evidence to indicate the extent to which current needs are met with respect to ADHD.

Until further research is done to identify how content can best be optimized for people with ADHD, it will be difficult to determine the extent to which the needs of people with ADHD are being met.

Given the high coincidence of learning disabilities and ADHD (Czamara, et al., 2013), it may not be possible to disentangle the needs associated primarily with ADHD on the basis of the disabilities presented. A user-centric approach with a series of personas may be more realistic. With further research, user needs associated primarily with ADHD may be identified. These are likely to be general rather than specific in nature due to the relatively-high coincidence of learning disabilities and ADHD (Czamara, et al., 2013).

**3.6.11 Potentials and possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-4)

Issues associated with ADHD, which do not have analogous issues associated with other learning disabilities, tend to be associated with:

* accuracy;
* working memory;
* sequencing;
* focus;
* rapid response.

This suggests that designs beneficial to people with ADHD should emphasize:

* clarity;
* concise content;
* distraction-free layout;
* consistent, simple-processing steps;
* robust error correction where forms are involved.

Anecdotal evidence (Sinfield, 2014), (Smith & Segal, n.d.) suggests that people with ADHD find easier to process and remember: visual representations, color coordination, and lists. However, color discrimination may be impaired in people with ADHD (Banaschewski, et. al., 2006), so color coordination must be used carefully. These features may prove useful in designing "ADHD friendly" content.

Much of the evidence to date, of the effectiveness of assistive technology and design techniques, with respect to ADHD, is anecdotal. In order to provide robust guidelines for supporting people with ADHD, more rigorous, evidence-based investigations, into which assistive technologies, tools and design techniques prove beneficial to people with ADHD, are required.

These investigations need not, however, meet the strict criteria of a clinical trial. Surveying people with ADHD, with regard to assistive technologies and design techniques that they find useful, combined with a series of product-preference tests, may provide insight on the criteria that should be used in recommending how content should be optimized for people with ADHD.

**3.6.12 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-5)

The prevalence of ADHD worldwide is 5.29% of the population. There is significant geographical and gender variation, with diagnosed incidences of ADHD being lowest in Africa and the Middle East; and higher in individuals of 18 years or younger (Polanczyk, et al., 2007). The cause of this variation is unclear. It may be a result of different attitudes to reporting and diagnosing the condition, rather than any actual variation in the prevalence of ADHD (Bussing, et. al., 1998), (Faraone, et al., 2003). If ADHD is under reported in females; Africa and the Middle East; and in the adult population; the worldwide incidence of ADHD must be higher than 5.29%.

The percent of school-aged children diagnosed with ADHD in the USA is estimated at 11%. The prevalence in males is slightly more than twice that of females (Centers for Disease Control and Prevention, 2014b). While the number of females diagnosed may be significantly under represented, this figure is likely to be a more-accurate representation of the global prevalence of ADHD. The percentage of children (4-17 years of age) diagnosed with ADHD in the USA has increased from 7.8% in 2003, to 11.0% in 2011, with an average annual increase of 5%. This represents an estimated increase of 2 million children diagnosed with ADHD in the USA between 2003 and 2011 (Centers for Disease Control and Prevention, 2014b). It is unclear if this represents an increase in the prevalence of ADHD, an increase in the reported incidences, or a combination of both.

The prevalence of ADHD in adults aged 18-44 in the USA in 2006 was estimated at 4.4% (Kessler, et al., 2006), suggesting that a significant number of cases of ADHD diagnosed in childhood may continue through adulthood. This may be an underestimation due to historic reporting biases.

**3.6.13 References to research.**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research.x)

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**3.7 Autism**[**§**](http://www.w3.org/TR/coga-user-research/#autism)

"Autism spectrum disorder (ASD) is a developmental disability that can cause significant social, communication and behavioral challenges. There is often nothing about how people with ASD look that sets them apart from other people, but people with ASD may communicate, interact, behave, and learn in ways that are different from most other people. The learning, thinking, and problem-solving abilities of people with ASD can range from gifted to severely challenged. Some people with ASD need a lot of help in their daily lives; others need less.

A diagnosis of ASD now includes several conditions that used to be diagnosed separately: autistic disorder, pervasive developmental disorder not otherwise specified (PDD-NOS), and Asperger syndrome. These conditions are now all called autism spectrum disorder." (See 2.)

**3.7.1 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-7)

1. "memory;
2. problem-solving;
3. attention;
4. reading, linguistic, and verbal comprehension;
5. math comprehension;
6. visual comprehension" (See 5.)

**3.7.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-6)

"People with ASD often have problems with social, emotional, and communication skills. They might repeat certain behaviors and might not want change in their daily activities. Many people with ASD also have different ways of learning, paying attention, or reacting to things. Signs of ASD begin during early childhood and typically last throughout a person's life.

Children or adults with ASD might:

* not point at objects to show interest (for example, not point at an airplane flying over);
* not look at objects when another person points at them;
* have trouble relating to others or not have an interest in other people at all;
* avoid eye contact and want to be alone;
* have trouble understanding other people's feelings or talking about their own feelings;
* prefer not to be held or cuddled, or might cuddle only when they want to;
* appear to be unaware when people talk to them, but respond to other sounds;
* be very interested in people, but not know how to talk, play, or relate to them;
* repeat or echo words or phrases said to them, or repeat words or phrases in place of normal language;
* have trouble expressing their needs using typical words or motions;
* not play 'pretend' games (for example, not pretend to 'feed' a doll);
* repeat actions over and over again;
* have trouble adapting when a routine changes;
* have unusual reactions to the way things smell, taste, look, feel, or sound;
* lose skills they once had (for example, stop saying words they were using)". (See 2.)

Different list of symptoms:

* poor social skills;
* difficulty with change and transition;
* impairments in executive function;
  + "manage time and attention;
  + switch focus;
  + plan and organize;
  + remember details;
  + curb inappropriate speech or behavior;
  + integrate past experience with present action". (See 6.)
* sensory integration:
  + sensitivity to physical contact;
  + sensitivity to loud noises;
* stereotypy;

**3.7.3 Their Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#their-challenges-2)

**3.7.3.1 How Symptoms Result in Challenges for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#how-symptoms-result-in-challenges-for-this-group)

* may not pay attention to primary content because distracted by secondary content;
* may be confused by:
  + instructions that are not well-defined;
  + transitions among content-delivery types (e.g., text to video);
  + presentations of content using different formats or designs.
* may not participate in web-based interactions with other people;
* may not recall instructions when subsequently presented with an action to perform;
* may react negatively to auto-playing video or audio.

**3.7.3.2 Observations from Interview with Anonymous User X**[**§**](http://www.w3.org/TR/coga-user-research/#observations-from-interview-with-anonymous-user-x)

* Positive: web facilitates social communication between those who struggle with face to face communication.
* Negative: communication via the web allows people with ASD to become even more isolated.
* Often the web is avoided except for work or communication purposes as it is not very user friendly.
* Some websites specifically are avoided due to the predominant color (red is particularly bad).
* In many cases there are some very-useful accessibility features that users of websites and applications have the option to adjust. However, it is often difficult to find out how and where to do this. (See 10.)

**3.7.3.3 Suggestions from Interview with Anonymous User X**[**§**](http://www.w3.org/TR/coga-user-research/#suggestions-from-interview-with-anonymous-user-x)

* It is easier to view websites that are more visual and use only plain, simple language that doesn't contain any jargon.
* Numerous search results can be difficult to sort through to find the right link. Therefore, easy-to-access links are more helpful without many options.
* Font: very much a personal preference. However, in general:
  + big, plain fonts at least 12 point;
  + bold fonts not skinny;
  + sites that allow users to customize the font to their own preferences.
* color coordination for different parts of the site relating to each other;
* key for different colors for different sections;
* in some cases, poor concept of time means can be looking at one site/page/document for many hours without realizing - timer on screen to alert user to how long they have been on that page. (See 10.)

**3.7.4 Some Personas with Use Cases That Address Key Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#some-personas-with-use-cases-that-address-key-challenges-1)

**3.7.4.1 Scenario A: Use a Web Browser to Open a Web Page**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-a-use-a-web-browser-to-open-a-web-page)

"Trevor" is a bright 18-year-old who plays games and watches music videos on his laptop. He lives at home with his parents and younger sister. He attends a special school where the teachers and staff can help with his social and communication challenges from his Autism Spectrum Disorder, while he works to pass his high-school exams.

He has problems with visual information and recognizing things on the page. His reading skills are not helped by his trouble concentrating on the page or screen long enough to read. His teachers showed him how to make the text bigger on the page. They told him how to use a printable view to hide all the ads with moving images that distract him, because he reads every word on the page very carefully and literally. He can be easily confused by colloquialisms and metaphors. He can also be overwhelmed by sites that offer too many choices.

He likes using the school's forum to talk to his friends. It's easier to just read what they want to say than to listen and try to figure out their facial expressions.

He shares a laptop with the family, but has first dibs on it because his parents want him to get his schoolwork done. He uses it for homework, but he really likes games with repetitive actions. He doesn't like new sites much, in the same way that he doesn't like any changes in his routine: they are tolerated, but not encouraged." (See 8, 9.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Activate / open the web browser. | Remember how to start the web browser. |  |  |
| 2. Open the website. | Recall the web address and know how to invoke it with the web browser. | Enter the web address. |  |
| 3. Navigate the website. | Familiarize / recall how to use it; and understand icons/text labels and navigation menus. |  |  |
| 4. View a web page. | Comprehend the content without being distracted by advertisements, extraneous content, etc.. | Increase font size and/or activate the print view of the web browser. | The solutions may be mutually exclusive. |

**3.7.4.2 Scenario B: Send an Email Message**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-b-send-an-email-message)

Middle-aged female with PDD-NOS (Pervasive Development Disorder-Not Otherwise Specified). She experiences significant social deficits and meets all the diagnostic criteria for autistic disorder, but her stereotypical and repetitive behaviors are noticeably mild. She finds it easier to send an email message than communicate via speech with people as it eliminates any social anxiety she may experience when interacting with people in person.

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| --- | --- | --- | --- |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Turn on computer. |  |  |  |
| 2. Launch email application. | The first issue here arises from the glaring white background that is often used in email applications, along with poorly-contrasted small fonts. Although there are options for changing some of the design settings, these are often hard to find and difficult to navigate. |  |  |
| 3. Select button to compose new email message. | Users with autism have a tendency to take a literal understanding of what people say and write. Therefore, the users may not understand any connotations, and are also prone to perhaps lack emotion in their own writing. There is a potential issue here as what users write may come across as unnecessarily blunt even though this is unintended. Similarly, users may misinterpret what is written to them by not understanding the connotations. When reading emails, users with ASD will often break down lengthy emails into more manageable chunks and edit the style/size/color of font. |  |  |
| 4. Type in address of recipient. | Facilitate comprehension and minimize distractions. | Increase font size and/or activate the print view of the web browser. |  |
| 5. Send email message. |  |  |  |

**3.7.4.3 Scenario C: Buy a Train Ticket Online**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-c-buy-a-train-ticket-online)

Older male with Asperger Syndrome who does not have any cognitive impairment. However, he exhibits repetitive behavior and has significant trouble with social situations, specifically communicating with others. He prefers to buy his train tickets online as it eliminates any social interaction which he is not keen on. He struggles to communicate with others successfully. He has extreme anxiety. He has been either unable to purchase a ticket in person, or ended up with the wrong ticket through his lack of ability to express what he needs specifically to the ticket-office attendant. When buying train tickets, there is noticeable task avoidance amongst many people on the spectrum.

|  |  |  |  |
| --- | --- | --- | --- |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Turn on computer. |  |  |  |
| 2. Open web browser. |  |  |  |
| 3. Type in web address for train ticket booking website. |  |  |  |
| 4. Select icon for booking train tickets. |  |  |  |
| 5. Tick box for 'return'. |  |  |  |
| 6. Type in departure and arrival locations. |  |  |  |
| 7. Select date and time for outbound and return journeys. |  |  |  |
| 8. Select number of adult and child passengers. |  |  |  |
| 9. Tick box for railcards. |  |  |  |
| 10. Select railcard type and number that apply for this journey. |  |  |  |
| 11. Select continue. |  |  |  |
| 12. Tick box to select specific outward & return journeys (details to look at: time, price, class and single/return). | May have a poor concept of time, meaning it is difficult to calculate if a train will arrive in time, especially where the journey involves changing trains. |  |  |
| 13. Select 'buy now'. |  |  |  |
| 14. Tick box to reserve seat and if so select seating preferences- optional. |  |  |  |
| 15. Tick box to either: collect tickets from self-service ticket machine and select station; or have tickets sent by post. |  |  |  |
| 16. Select 'continue'. |  |  |  |
| 17. Tick box 'new user'. |  |  |  |
| 18. Type in personal details (Name, Address, Email, etc.). |  |  |  |
| 19. Tick box payment card type (Visa, MasterCard, etc.). |  |  |  |
| 20. Enter card details (number, expiry date, name, security code). |  |  |  |
| 21. Type in home address. |  |  |  |
| 22. Tick box to agree to terms and conditions and select 'buy now'. |  |  |  |
| 23. Enter payment-card secure-bank password. |  |  |  |
| 24. Click 'Submit' button. |  |  |  |

**3.7.4.4 Scenario D: Shop an Online Supermarket**[**§**](http://www.w3.org/TR/coga-user-research/#scenario-d-shop-an-online-supermarket)

Young adult male with 'classic' Autism. He has a severe cognitive delay and is non-verbal, a side effect of which is extreme social inhibition. He is able to communicate via pictures when necessary with his family and carers. A local supermarket is a good example of a place where he can easily become overwhelmed, which severely affects his ability to communicate effectively. However, in the comfort of his own home he is much better able to function, and therefore is less dependent upon others for help. The task of online shopping is made much easier if a very- specific item is required and there is little choice.

|  |  |  |  |
| --- | --- | --- | --- |
| **Step** | **Challenge** | **Solutions** | **Comments** |
| 1. Turn on computer. |  |  |  |
| 2. Open web browser. |  |  |  |
| 3. Type in web address for online supermarket website. |  |  |  |
| 4. Select 'food and drink' and then 'buy groceries'. | Entering a search item may produce many results. This can be confusing if they are all similar, as it can be difficult to choose which one is best. | Increase font size and/or activate the print view of the web browser. |  |
| 5. Select groceries to purchase. | Most items available for purchase will have an image alongside their descriptive text. This should help when choosing the correct items. However, there is a level of inconsistency across different online supermarket shops regarding the images they use to denote each their products. This can be very confusing. |  |  |
| 6. Select 'buy now'. |  |  |  |
| 7. Log in with user name and password. |  |  |  |
| 8. Select delivery date and time. |  |  |  |
| 9. Type in delivery-address details. |  |  |  |
| 10. Select payment method. |  |  |  |
| 11. Type in payment-card details. |  |  |  |
| 12. Select 'order'. |  |  |  |

**3.7.5 How People with Cognitive Disabilities Use Optimized Content and Special Pages**[**§**](http://www.w3.org/TR/coga-user-research/#how-people-with-cognitive-disabilities-use-optimized-content-and-special-pages-2)

**3.7.6 Characteristics of Content Optimized for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-5)

**3.7.6.1 Consistency**[**§**](http://www.w3.org/TR/coga-user-research/#consistency)

* "Ensure that navigation is consistent throughout a site.
* Similar interface elements and similar interactions should produce predictably similar results." (See 7.)

**3.7.6.2 Transformability**[**§**](http://www.w3.org/TR/coga-user-research/#transformability)

* "Support increased text sizes.
* Ensure images are readable and comprehensible when enlarged.
* Ensure color alone is not used to convey content.
* Support the disabling of images and/or styles." (See 7.)

**3.7.6.3 Multi-modality**[**§**](http://www.w3.org/TR/coga-user-research/#multi-modality)

* "Provide content in multiple mediums.
* Use contextually-relevant images to enhance content.
* Pair icons or graphics with text to provide contextual cues and help with content comprehension." (See 7.)

**3.7.6.4 Focus and Structure**[**§**](http://www.w3.org/TR/coga-user-research/#focus-and-structure)

* "Use white space and visual design elements to focus user attention.
* Avoid distractions.
* Use stylistic differences to highlight important content, but do so conservatively.
* Organize content into well-defined groups or chunks, using headings, lists, and other visual mechanisms.
* Use white space for separation.
* Avoid background sounds." (See 7.)

**3.7.6.5 Readability and Language**[**§**](http://www.w3.org/TR/coga-user-research/#readability-and-language)

* "Use language that is as simple as is appropriate for the content.
* Avoid tangential, extraneous, or non-relevant information.
* Use correct grammar and spelling.
* Use a spell-checker. Write clearly and simply.
* Maintain a reading level that is adequate for the audience.
* Be careful with colloquialisms, non-literal text, and jargon.
* Expand abbreviations and acronyms.
* Provide summaries, introductions, or a table of contents for complex or lengthy content.
* Be succinct.
* Ensure text readability.
  + Line height: The amount of space between lines should generally be no less than half the character height.
  + Line length: Very long lines of text (more than around 80 characters per line) are more difficult to read.
  + Letter spacing, word spacing, and justification: Provide appropriate (but not too much) letter and word spacing. Avoid full justified text as it results in variable spacing between words and can result in distracting "rivers of white" - patterns of white spaces that flow downward through body text.
  + Sans-serif fonts: These fonts are generally regarded to be more appealing for body text.
  + Adequate text size (Very small text): Text should generally be at least 10 pixels in size.
  + Content appropriate fonts: Visually appealing and content-appropriate fonts affect satisfaction, readability, and comprehension.
  + Paragraph length: Keep paragraph length short.
  + Adequate color contrast: Ensure text is easily discerned against the background and that links can be easily differentiated from surrounding text.
  + No horizontal scrolling: Avoid horizontal scrolling when the text size is increased 200-300%." (See 7.)

**3.7.6.6 Orientation and Error Prevention/Recovery**[**§**](http://www.w3.org/TR/coga-user-research/#orientation-and-error-prevention-recovery)

* Give users control over time sensitive content changes: Avoid automatic refreshes or redirects. Allow users to control content updates or changes. Avoid unnecessary time-outs or expirations. Allow users to request more time.
* Provide adequate instructions and cues for forms: Ensure required elements and formatting requirements are identified. Provide associated and descriptive form labels and fieldsets/legends.
* Give users clear and accessible form error messages and provide mechanisms for resolving form errors and resubmitting the form.
* Give feedback on a user's actions: Confirm correct choices and alert users to errors or possible errors.
* Provide instructions for unfamiliar or complex interfaces.
* Use breadcrumbs, indicators, or cues to indicate location or progress: Allow users to quickly determine where they are at in the structure of a web site (e.g., a currently active "tab" or Home > Products > Widget, for example) or within a sequence (Step 2 of 4). Next/Previous options should be provided for sequential tasks.
* Allow critical functions to be confirmed and/or canceled/reversed.
* Provide adequately-sized clickable targets and ensure functional elements appear clickable: Use labels for form elements, particularly small checkboxes and radio buttons, and ensure all clickable elements appear clickable and do not require exactness.
* Use underline for links only.
* Provide multiple methods for finding content: A logical navigation, search functionality, index, site map, table of contents, links within body text, supplementary or related links section, etc. all provide multiple ways for users to find content." (See 7.)

**Specific Technologies**[**§**](http://www.w3.org/TR/coga-user-research/#autism)

Add section

**3.7.7 Summary of Existing Research and Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines-3)

Add literary summary.

**3.7.7.1 Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#guidelines-1)

* [Cognitive Web Accessibility Checklist](http://wave.webaim.org/cognitive) (Last Updated September 2, 2009). WebAIM, Center for Persons with Disabilities, Utah State University.
* Friedman M, Bryen D (2007). [Web accessibility design recommendations for people with cognitive disabilities](http://iospress.metapress.com/content/g8j2244361428655/). Technology and Disability; 19(4): 205-212.
* [Designing websites suitable for people with autism spectrum disorders](http://www.autism.org.uk/working-with/leisure-and-environments/designing-websites-suitable-for-people-with-autism-spectrum-disorders.aspx) (Last Updated March 16, 2008). The National Autistic Society.
* Poulson D, Nicolle C (2004). [Making the Internet accessible for people with cognitive and communication Impairments](http://dl.acm.org/citation.cfm?id=1011732&dl=ACM&coll=&preflayout=flat). Universal Access in the Information Society; 3(1): 48-56.
* [Telecommunications Problems and Design Strategies for People with Cognitive Disabilities](http://www.wid.org/publications/telecommunications-problems-and-design-strategies-for-people-with-cognitive-disabilities) (Last Updated August 16, 1999). World Institute on Disability.

**3.7.8 Extent to Which Current Needs Are Met**[**§**](http://www.w3.org/TR/coga-user-research/#extent-to-which-current-needs-are-met-6)

Review challenges and describe where needs are met. Identify gaps

**3.7.9 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-5)

Notes for further research:

1. Add RDF implementation from Lisa Seeman's [Natural Language Usage - Issues and Strategies for Universal Access to Information](http://www.w3.org/WAI/PF/natural-lang-20030326.html).
2. Review accommodation possibilities in "[Accommodating Students with Disabilities in Science, Technology, Engineering, and Mathematics (STEM)" (PDF)](http://www.catea.gatech.edu/scitrain/accommodating.pdf). See info starting on page 93.
3. Review accommodations listed in Katie Haritos-Shea's online course, "Accessible Science Classrooms," specifically the information on accommodations, starting in [Module 7: Autism Spectrum Disorders](http://www.catea.gatech.edu/scitrain/science/modules/autism/module9_1.php?version=free).

**3.7.10 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-6)

The United States Centers for Disease Control and Prevention estimate 1 in 68 children has been identified with autism spectrum disorder. The data show autism spectrum disorders are almost five times more common in boys than girls; and more common in white children than African-American or Hispanic children. (See 3.) Studies in Asia, Europe, and North America have identified individuals with ASD with an average prevalence of about 1%. (See 1.) A study in South Korea reported a prevalence of 2.6%. (See 4.)

**3.7.11 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research-4)

1. [Autism Spectrum Disorder (ASD): Data & Statistics](http://www.cdc.gov/ncbddd/autism/data.html), United States Centers for Disease Control and Prevention, 24 March 2014.
2. [Autism Spectrum Disorder (ASD): Facts About ASD](http://www.cdc.gov/ncbddd/autism/facts.html), United States Centers for Disease Control and Prevention, 20 March 2014.
3. [Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States](http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6302a1.htm?s_cid=ss6302a1_w), Surveillance Summaries; 63(SS02): 1-21, Jon Baio, Editors. National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, 2014.
4. [Prevalence of autism spectrum disorders in a total population sample](http://www.ncbi.nlm.nih.gov/pubmed/21558103), American Journal of Psychiatry; 170(6): 689, Y. Kim, B. Leventhal, Y. Koh, et. al., 2013.
5. [Cognitive Disabilities](http://webaim.org/articles/cognitive/), WebAIM, Center for Persons with Disabilities, Utah State University, 9 August 2013.
6. [Executive Function Skills and Disorders](http://www.webmd.com/add-adhd/guide/executive-function), WebMD, LLC., 16 April 2012.
7. [Cognitive Web Accessibility Checklist](http://wave.webaim.org/cognitive), WebAIM, Center for Persons with Disabilities, Utah State University, 2 September 2009.
8. [Book Excerpt: A Web for Everyone](http://uxmag.com/articles/book-excerpt-a-web-for-everyone), UX Magazine, 7 April 2014.
9. [A Web for Everyone: Designing Accessible User Experiences](http://rosenfeldmedia.com/books/a-web-for-everyone/), S. Horton, W. Quesenbery, January 2014.
10. Autism Challenges and Avoidances, Interview of Anonymous User X, N. Milliken, J. Grainger, 17 June 2014.

**3.8 Dyscalculia**[**§**](http://www.w3.org/TR/coga-user-research/#dyscalculia)

Dyscalculia is a learning disability specifically-related to mathematics. People with dyscalculia have significant problems with numbers and mathematical concepts, but still have a normal or above-normal IQ. Few people with dyscalculia have problems with math alone. Many also struggle with problems being able to learn to tell time, left/right orientation, rules in games, and much more.

Researchers have yet to come to a final conclusion with just how many types of dyscalculia exist. David Geary has broken the disability down into 4 main areas: semantic-retrieval dyscalculia; procedural dyscalculia; visuospatial dyscalculia; and number-fact dyscalculia.

It should be noted that this is the opinion of just one researcher. There are many other well-established categories for dyscalculia. One such example is published in the Journal of Learning Disabilities, and has arisen from the research of Kosc Ladislav. He has broken Developmental Dyscalculia into 6 areas: verbal, practognostic, lexical, graphical, ideognostical, and operational-developmental. (10)

Diana Laurillard (Professor of Learning with Digital Technologies at the Institute of Education, London) - "Although they [individuals with dyscalculia] can count, they do not see the relationships between numbers - e.g., that 5 is made up of 2 and 3. For them, it is just a sequence, like the alphabet. We do not see E as made up of B and C, because it's not. It's just later in the sequence."

The UK DfES (Department for Education & Skills) described dyscalculia in its National Numeracy Strategy:

"Dyscalculia is a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence."

**3.8.1 Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#cognitive-functions-8)

Genetic, neurobiological, and epidemiologic evidence indicates that dyscalculia, like other learning disabilities, is a brain-based disorder. Some research suggests it may be the result of an altered neural substrate.

It has also been suggested that poor teaching and environmental deprivation may compound the condition (9).

Because the neural network of both hemispheres comprises the substrate of normal arithmetic skills, dyscalculia can result from dysfunction of either hemisphere, although the left parietotemporal area is of particular significance according to UCL Institute of Cognitive Neuroscience. The debate as to whether the left or right parietotemporal area is linked with dyscalculia is hotly contested. However, there is more research pointing towards a fault in the left parietotemporal area.

There is some research to suggest that dyscalculia may occur as a consequence of prematurity and low birth weight, and is frequently encountered along with a variety of other neurological disorders, such as: attention-deficit hyperactivity disorder (ADHD), developmental-language disorder, epilepsy, and Fragile X Syndrome. Developmental dyscalculia has proven to be a persistent learning disability, at least for the short term, in about half of affected preteen pupils (2). Dyscalculia can also occur later in life as a result of a brain lesion or other traumatic brain injury.

**3.8.2 Symptoms**[**§**](http://www.w3.org/TR/coga-user-research/#symptoms-7)

Common symptoms include:

* normal/accelerated language acquisition (Good visual memory for the printed word. Good in areas of science, geometry and creative arts until a level of higher math skill is required, and where figures use logic not formula);
* mistaken recollection of names (Poor name/face retrieval);
* difficulty with abstract context of time and direction;
* poor mental math ability;
* mistakes commonly made when manipulating numbers;
* inability to grasp and remember math concepts;
* inability to comprehend or 'picture' mechanical processes;
* poor memory of the layout of things;
* poor sense of direction;
* difficulty grasping concepts of formal music education;
* struggles with spatial orientation;
* poor athletic coordination;
* difficulty when playing games.

**3.8.3 Their Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#their-challenges-3)

**Memory:** Poor long-term memory, resulting in an inability to remember names (despite recognizing faces). Inability to recall schedules or sequences, e.g., dance steps and musical-instrument fingering. Unable to remember rules in sports and other games, such as card games. Difficulty remembering whose turn it is.

**Numbers:** Difficulty with numbers, specifically in cases of addition, subtraction, omission, reversal, and transposition. Inability to count, especially when asked to begin counting at a number other than 1. Particular difficulty with numbers with zeros and their relationships to each other, such as 10, 100, 1000.

**Abstract Concepts:** Poor concept mastery, resulting in an inability to grasp math concepts. Lack of ability for visualization, such as numbers on a clock face; and recognizing geographical locations and where they are in relation to these locations. Limited capability for strategic planning, such as in chess. Difficulties with spatial orientation, such as distinguishing left from right and north, south, east, and west. Inability to grasp the concept of time or direction, frequently lost/late, trouble telling time. Difficulty handling money. (Many adults with dyscalculia find themselves overdrawn as a result of this.) Difficulty in planning for long term with a tendency to focus on the present or the near future.

**Coordination:** Poor athletic coordination, resulting in difficulty keeping up with rapidly-changing physical directions.

**The inability to grasp abstract concepts translates to more practical situations.**

**Financial Planning:** Due to the combination of the inability to grasp the concept of money and poor long term memory, financial planning is particularly challenging for people with dyscalculia. The actual value of products means very little. People with dyscalculia can also struggle with purchasing the correct quantities. For example, when buying food at the supermarket, often far too much or too little is bought. When change is given in shops, few people with dyscalculia are able to correctly calculate how much money they have and how much they should have been given back. As a result of all of this, many people with dyscalculia are consistently overdrawn, and rely heavily on others for help.

**Currency:** Following on from the inability to grasp the concept of money, foreign currency is particularly difficult to comprehend, especially as exchange rates are often changing, and calculations are often involved when trying to convert one currency to another.

**Temperature:** Temperature is meaningless when told in numbers, especially when both Celsius and Fahrenheit are used.

**Traveling:** Few people with dyscalculia learn to drive as driving is heavily reliant upon numbers (speed limits, petrol gauge, distances, etc.). This means many must rely upon buses and trains for transport. Getting the right bus/train at the right time, and on the correct platform, are huge problems because each involves the use of numbers and time.

**3.8.4 Some Personas With Use Case that Address Key Challenges**[**§**](http://www.w3.org/TR/coga-user-research/#some-personas-with-use-case-that-address-key-challenges)

**3.8.4.1 Booking a Train Ticket Online**[**§**](http://www.w3.org/TR/coga-user-research/#booking-a-train-ticket-online)

Scenario A "Jenny" is a person with dyscalculia. She is a mother with two young children. She is trying to book train tickets online for herself and her children. The train journey involves one change where she must walk to a different platform. She must also ensure her first train arrives at the change destination with enough time for her to find the correct platform before the train sets off for the second part of her journey. She needs to be able to book the tickets for the correct time, and with the appropriate rail card, to be able to qualify for discounts. She also needs to be able to remember her password for her bank's security system so she can purchase the tickets. This password is made up of a combination of letters and numbers to fulfill the bank's 'secure-password' criteria.

|  |  |
| --- | --- |
| Booking a train ticket online | |
| **Step** | **Challenges** |
| Tick box for 'return'. | no challenges |
| Type in from and to destinations. | no challenges |
| Select date and time for outbound & return journeys. | This step is particularly difficult as it requires the entry of a date and a time for travel. People with dyscalculia have a limited ability to grasp the concept of time. Therefore, they may struggle to work out when their train journey is, and also how far away the date and time of their journey is from the current date and time. |
| Select number of adult & child passengers. | This step may prove difficult as dyscalculia can reduce a person's ability to count. However, if the numbers are not too high and the counting begins at 1, usually this is achievable. |
| Tick box for rail cards. | no challenges |
| Select rail-card type and number that apply for this journey. | This step again involves counting. However, as above, if the numbers aren't too high this shouldn't prove too difficult. |
| Select continue. | no challenges |
| Tick box for outward & return journeys. (Details to look at: time, price, class & single/return.) | In this step, the only challenge is the selection of the time of the journey. As mentioned above, people with dyscalculia struggle with the concept of time. Therefore, they may be liable to selecting a return journey that occurs before the outward journey. Fortunately, most if not all online train-ticket applications will not allow the transaction to proceed if this is the case. The error will be flagged in red. |
| Select 'buy now'. | no challenges |
| *Tick box to reserve seat and, if so, select seating preferences - optional.* | no challenges |
| Tick box to collect tickets from self-service ticket machine and select station or tick box to have tickets sent by post. | This is not directly an issue at the point of purchase. However, collecting tickets from a self-service ticket machine can be very difficult for people with dyscalculia. The ticket-collection reference number used to validate the purchase is made up of an entirely random mix of numbers; and upper & lower case letters. It would be almost impossible to commit this reference number to memory, or to find a pattern in it. Therefore, it must copied out, which gives rise to sequencing issues resulting in the numbers being inputted in the wrong order. The whole process could take a very long time. |
| Select 'continue'. | no challenges |
| Tick box 'new user'. | no challenges |
| Type in personal details (name, address, email, etc.). | no challenges |
| Tick box payment card type (Visa, MasterCard, etc.). | no challenges |
| Enter card details (number, expiration date, name, security code). | Although this step does involve numbers, it does not require any manipulation of numbers, such as addition, subtraction, etc.. Therefore, the act of typing the numbers from the card into the website should be achievable. However, some people may struggle with sequencing and end up typing the numbers out of order. |
| Type in post code and tick box 'find billing address'. | no challenges |
| Tick box to agree to terms and conditions and select 'buy now'. | no challenges |
| Enter payment card secure bank password. | This step is likely to prove most difficult as it requires the use of long-term memory (LTM), which may be fairly limited in people with dyscalculia. Also, the customer is required to enter a password out of its usual order. For example, the customer may be asked to enter the 3rd, 5th, and 7th characters in the password. As people with dyscalculia struggle with the concept of numbers and sequences, this step may be achievable only by having the password written down in front of them. However, this then reduces the security of their payment method. |
| Order complete. | no challenges |

**3.8.4.2 Using Online Banking to Pay Someone New**[**§**](http://www.w3.org/TR/coga-user-research/#using-online-banking-to-pay-someone-new)

Scenario B "Emily" is a high-school student who struggles to understand many of the topics covered in her math, science, and music lessons. She needs to use her online-banking account to transfer some money into a friend's bank account. She hasn't transferred money online to this friend before, so she must set up a new user. This requires using a card reader; and typing in a code that appears on the card reader only for 30 seconds before it changes to increase security.

|  |  |
| --- | --- |
| Using online banking to pay someone new | |
| **Step** | **Challenges** |
| Type in customer number and select 'log in'. | This step is challenging because a person is required to use LTM to type in a customer number. People with dyscalculia typically have poor LTM and difficulty with sequencing. Therefore, again, they may need to have the password written down. This is then a breach of security. |
| Type in 3 random digits from pin number (e.g. 1st, 3rd, 4th).  Type in 3 random characters from password (e.g. 2nd, 5th, 10th). | This requires users to access their LTM to remember the password, and then be able to count up each of the numbers/letters to enter the correct characters out of their normal pattern. Counting is hard for people with dyscalculia, especially when it doesn't begin at 1, which increases the difficulty of these 2 tasks. |
| Select 'payments and transfers' and then 'go'. | no challenges |
| Select 'pay someone new'. | no challenges |
| Enter details of payee and select 'add payee'. | This task does require numbers, so it may be a challenge. However, the numbers need to be copied and not manipulated, which reduces the complexity. |
| Type in amount to transfer. | Calculating numbers is particularly difficult for people with dyscalculia because their grasp of math concepts and rules is typically quite poor. Therefore, this task could be very challenging. |
| Follow on-screen instructions to verify new payee.  --> Turn on card reader and select function button --> Insert card into card reader --> Type in pin number to card reader --> Type in numbers on the computer screen into the card reader, select 'ok' on the reader --> Type the number that appears on the screen of the card reader into the box online --> Click confirm on the website. | This task is likely to be the most challenging of the transaction due to time constraints that are in place for security reasons. Firstly, users must type their pin number into the card reader, which requires the use of LTM. However, this can be achieved as often people with dyscalculia are able to remember their pin number as a pattern. Then the user must enter the numbers on the computer screen into the card reader. This shouldn't be too difficult because it requires only copying the numbers. The user must then enter numbers, which appear on the screen of the card reader, into a text box on the website. This stage is fairly difficult because the numbers on the card reader change every 30 seconds to increase security. Therefore, the numbers must be typed in fairly quickly. Also, many people with dyscalculia struggle to understand the concept of time. Therefore, they may find it difficult to work out quite how quickly they must enter the numbers before they change. |
| Payment complete. | no challenges |

**3.8.4.3 Changing Payment Details for an Online Supermarket Shop**[**§**](http://www.w3.org/TR/coga-user-research/#changing-payment-details-for-an-online-supermarket-shop)

Scenario C "George" is an elderly gentleman who doesn't like to leave his house, does his supermarket shopping online once a week, and gets it delivered to his door. His bank details are stored on the shopping website so he doesn't have to keep typing them in. However, he has just been sent a new bank card because his old one has expired. Thus, he must re-enter all the details necessary to complete his shop.

|  |  |
| --- | --- |
| Changing the payment details for an online supermarket shop. | |
| **Step** | **Challenges** |
| Select 'food and drink' and then 'buy groceries'. | no challenges |
| Log in with user name and password. | no challenges |
| Delete old payment card. | no challenges |
| Select 'add payment card', | no challenges |
| Type in the card details | This task should be easily achievable because it does not require any manipulation of the numbers. Also, the numbers do not need to be remembered because they are printed on the card. However, people with dyscalculia struggle with sequencing, and therefore may be liable to typing the numbers out of the correct order. |
| Tick box 'make this my preferred payment card'. | no challenges |
| Select 'save' and then either continue shopping or log out. | no challenges |

**3.8.4.4 Online Shopping**[**§**](http://www.w3.org/TR/coga-user-research/#online-shopping)

Whilst people with dyscalculia may find it relatively simple to set up an online shopping account, it is far harder to complete the actual task of shopping. This stems from the inability to grasp the concept of money, and the amount a product costs, in relation to the amount of money they might have in their bank account. As a result of this, people with dyscalculia frequently find themselves overdrawn. The task of calculating numbers to produce a final figure, which has some meaning to them as opposed to being a collection of random numbers, is a concept they cannot master. This often leads to active avoidance of the task, or strong reliability on others, neither of which is a sustainable solution. Quantities are also an abstract concept. People with dyscalculia often buying far too much or not-nearly enough because it is difficult for them to work out exactly how much they need. Anything that involves weights and measures, e.g. 1 kg of potatoes, is also almost impossible to understand.

**3.8.5 How They Use the Web and ICT**[**§**](http://www.w3.org/TR/coga-user-research/#how-they-use-the-web-and-ict-3)

There is very little in the way of specific assistive technologies for dyscalculia. One person reports using Smart sum - more research required.

<http://www.dyscalculator.com/> is a talking calculator, which is designed for dyscalculia.

**3.8.6 How People with Dyscalculia Use Optimized Content and Special Pages**[**§**](http://www.w3.org/TR/coga-user-research/#how-people-with-dyscalculia-use-optimized-content-and-special-pages)

Many people with dyscalculia report they enjoy using the Internet. There are quite a lot of people with dyscalculia using social media and online video. There is little if any optimized content available for dyscalculia. The scenarios give examples of where dyscalculia impacts people using products and services on the Internet.

**3.8.7 Characteristics of Content Optimized for This Group**[**§**](http://www.w3.org/TR/coga-user-research/#characteristics-of-content-optimized-for-this-group-6)

[Assistive Technology Devices for Students Struggling in Mathematics from the Georgia Department of Education](http://archives.gadoe.org/DMGetDocument.aspx/Math_Chart_revised_8-10.pdf?p=6CC6799F8C1371F6CFC3EAE26FFD23831AA37596E6C907F54E26E070D9A5463C&Type=D%20)

There is further research needed before we are in a position to add descriptions of key features and how it helps users overcome challenges. Very little work has been done on this topic.

**3.8.8 Summary of Existing Research and Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#summary-of-existing-research-and-guidelines-4)

It is widely acknowledged that dyscalculia was first discovered in 1919 by Salomon Henschen, a Swedish neurologist who found that it was possible for a person of high general intelligence to have impaired mathematical abilities. At the time, it was known as 'number blindness'. The term 'dyscalculia' was later coined by Dr. Josef Gerstman in the 1940s. When compared with dyslexia and other similar learning disabilities, dyscalculia receives relatively little recognition. There is still limited awareness of its existence.

Although there are many classifications of dyscalculia, it can be broken down into 3 sections; developmental dyscalculia (inherited/acquired during prenatal or early developmental period); post-lesion dyscalculia (acquired during an incident of traumatic brain injury affecting specific areas of the brain); and pseudo-dyscalculia (a result of inadequate instruction).

Formal definition: The Department for Education Skills (DfES) defines dyscalculia as: "A condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts; lack an intuitive grasp of numbers; and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence."

**3.8.8.1 Etiology**[**§**](http://www.w3.org/TR/coga-user-research/#etiology)

Adult neuropsychological and neuroimaging research points to the intraparietal sulcus as a key region for the representation and processing of numerical magnitude (4). This raises the possibility of a parietal dysfunction as a root cause of dyscalculia (4). The following two studies support this research.

Virtual Dyscalculia Induced by Parietal-Lobe TMS Impairs Automatic Magnitude Processing

UCL scientists state that dyscalculia is a result of a malformation in the right-parietal lobe in the brain. However, the underlying dysfunction is relatively unknown (c.07). The study involved using neuronavigated transcranial magnetic stimulation (TMS) to stimulate the brain and cause dyscalculia, only for a few hundred milliseconds, in typical individuals. The subjects then completed math tasks whilst under stimulation, and produced dyscalculia-like behavior. However, when the left-parietal lobe was stimulated under TMS, this behavior was not observed. Therefore, it can be reasonably assumed there is a causal relationship between defects in the right-parietal lobe and dyscalculia. (3)

The above research is supported by the following research study: Impaired parietal magnitude processing in developmental dyscalculia. This study was conducted by Gavin R. Price, Ian Holloway, Pekka Räsänen, Manu Vesterinen and Daniel Ansari. It shows that, in children with developmental dyscalculia, the right-intraparietal sulcus is not modulated in response to numerical processing demands to the same degree as in typically-developing children. This suggests a causal relationship between impairment of parietal-magnitude systems and developmental dyscalculia. (4)

Research by Shalev, et. al. suggests some families have a genetic predisposition to dyscalculia, resulting in prevalence 10x higher than in the general population. (5) Although dyscalculia cannot be cured, it is hoped early detection and remedial teaching can go a long way to reducing the effects of dyscalculia on the individual.

**3.8.8.2 Comorbidity**[**§**](http://www.w3.org/TR/coga-user-research/#comorbidity)

High comorbidity with ADHA (estimates range between 15-26%) and dyslexia (estimates range between 17-64%) (6). There is strong evidence to suggest Turners Syndrome and Gerstmann's Syndrome are associated with dyscalculia. (7)

**3.8.8.3 Guidelines**[**§**](http://www.w3.org/TR/coga-user-research/#guidelines-2)

Although there are no specific guidelines produced by a governing body, there are several ways to help individuals with dyscalculia improve their mathematical abilities.

* study sheets/summary sheets/outlines of most important facts;
* supplementary aids (vocabulary, multiplication cards, etc.);
* visual demonstrations;
* instructions/directions given in different channels (written, spoken, demonstration);
* visual or multi-sensory materials;
* mnemonic aids/devices.

Some more-useful guidelines regarding dyscalculia, specifically for school children, are available from Leeds City Council (PDF): Guidelines for Specific Learning Difficulties in Maths/Dyscalculia.

Dyscalculia is still a relatively-unknown disability with many of those affected by it not being diagnosed until later in life. Often, with children in schools especially, those affected are thought to be stupid or lazy because many people are unaware of dyscalculia's existence. This is analogous to the treatment of people with dyslexia.

**3.8.9 Potentials and Possibilities**[**§**](http://www.w3.org/TR/coga-user-research/#potentials-and-possibilities-6)

Add ideas for filling gaps.

**3.8.10 Prevalence**[**§**](http://www.w3.org/TR/coga-user-research/#prevalence-7)

Studies conducted by Gross-Tsur, Manor and Shalev in 1996 suggest that 6.5% of the population have dyscalculia. Conflicting research done by Lewis, Hitch and Walker in 1994 suggests that 1.3% of the population have dyscalculia, while 2.3% have dyscalculia and dyslexia. This puts the world population of people with dyscalculia at 3.6%. (8)

5-6% in school age children. (9)

This gives the rough estimate that between 3½ and 6½% of the world population is affected by dyscalculia. However, no international study has been done on how common it is.

Studies show the presentation of dyscalculia in males and females is roughly equal. Neither gender appears to have a greater predisposition than the other. (9)

**3.8.11 References to Research**[**§**](http://www.w3.org/TR/coga-user-research/#references-to-research-5)

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(4) Price, G.R., et. al. (2007). Impaired parietal magnitude processing in developmental dyscalculia. Current Biology, 17(24), 1042-43 Available from: <http://www.cell.com/current-biology/retrieve/pii/S0960982207020726>.

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(8) www.dyscalculiaforum.com

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(10) Ladislav, K. (1974). Developmental Dyscalculia. Journal of Learning Disabilities. 7(3) 164-177. Available from: <http://ldx.sagepub.com/content/7/3/164.short>.

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**4. Research on Cognitive Function**[**§**](http://www.w3.org/TR/coga-user-research/#research-on-cognitive-function)

This section aims to provide:

* a basis for consistent use of terms within our documents;
* a basis / background for making tags that can be used in meta data or functional-accessibility approach
* a useful resource

Note: We have taken terms and concepts from across the work we are doing on disability and cognitive function. Where more than one term exists for what seems to be a very similar function, we have chosen one term, but brought others for reference. We have also reviewed the [Caroll taxonomy](http://iapsych.com/articles/mcgrew2009.pdf), but it was focused on educational assessment, and psychometric-based models for human intelligence, and was therefore not fully-relevant (for example: knowledge categories). When quoting a Caroll category, we have tried to put the mnemonic after the term such as (RG) or (I).

Here are the cognitive functions that we have identified so far. They are not complete, and not yet in a taxonomy form.

**4.1 Reasoning and Executive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#reasoning-and-executive-functions)

**Executive functions** (also known as cognitive control and supervisory-attentional system) is an umbrella term for the management of cognitive processes such as reasoning and problem solving (goal-focused reasoning) as described below. Executive function also includes:

* emotional control and self-monitoring
* shift ( also called task flexibility)
* initiation
* planning/organization
* execution

Executive function also relies upon or includes: working memory, other memory (short, long), attention, abstraction, associations, as described below.

In making a decision or conclusion, we *may* use:

* **Fluid** (logical) reasoning;
* Attitudes and experience from or guiding **Crystallized intelligence**;
* An **Affective component** involving a person’s emotions (such as fear) and identity (sense of self).
* **Behavioral** (or cognitive) component involving memory, such as long-term autobiographical memory.

**4.1.1 Reasoning**[**§**](http://www.w3.org/TR/coga-user-research/#reasoning)

**Fluid reasoning** is the capacity to think logically and solve problems in novel situations, independent of acquired knowledge [[Fluid\_and\_crystallized\_intelligence](http://en.wikipedia.org/wiki/Fluid_and_crystallized_intelligence)] Fluid intelligence may involve both the dorsolateral prefrontal cortex and the anterior cingulate cortex.

Types of fluid reasoning are:

1. **Deductive Reasoning** (RG) (sometimes called General or Sequential or hypothetico-deductive reasoning). It is the ability to start with stated assertions (rules, premises, or conditions), and engage in one or more steps leading to a solution.
2. **Inductive Reasoning** (Induction (I) Reasoning from specific cases or observations to general rules or to broad generalizations. Often requires the ability to combine separate pieces of information in the formation of inferences, rules, hypotheses, or conclusions.
3. **Mathematical Intelligence** (also called Quantitative Reasoning (RQ) depends upon ability to inductively (I) and/or deductively (RG) reason with concepts involving mathematical relations and properties.
4. **Piagetian Reasoning** (PR): reasoning via *seriation* (organizing material into an orderly series that facilitates understanding of relationships between events), *conservation* (awareness that physical quantities do not change in amount when altered in appearance), and *classification*.

A related idea is Speed of Reasoning (RE): Speed or fluency in performing reasoning tasks [http://www-personal.umich.edu/~itm/688/wk6/CHC%20Definitions.pdf]

**Crystallized Intelligence** (sometimes called Comprehension Knowledge), is the ability to use skills, knowledge, and experience. It does not equate to memory, but it does rely on accessing information from long-term memory. Crystallized intelligence is one’s lifetime of intellectual achievement, as demonstrated largely through one's vocabulary and general knowledge. [[http://en.wikipedia.org/wiki/Fluid\_and\_crystallized\_intelligence</cite](http://en.wikipedia.org/wiki/Fluid_and_crystallized_intelligence)> Crystallized Intelligence involves storage and usage of long-term memories, such as by the hippocampus.

We have included the dependent aspects in the sections on memory and language [ http://www-personal.umich.edu/~itm/688/wk6/CHC%20Definitions.pdf]

**4.1.2 Attention**[**§**](http://www.w3.org/TR/coga-user-research/#attention)

Reasoning and executive functions require attention. Types of attention are the following.

* **Selective attention** refers to the ability to attend to some stimuli while disregarding others irrelevant to the task at hand. [http://www.ncbi.nlm.nih.gov/books/NBK3885/]
* **Divided attention** tasks require the processing of two or more sources of information, or the performance of two or more tasks at the same time. (Divided attention has usually been associated with significant age-related declines in performance, particularly when tasks are complex.) [[5](http://www.ncbi.nlm.nih.gov/books/NBK3885/#ch1.r5)]. The cost of dividing attention is assessed by comparing performance under dual-task conditions to performance when the tasks are performed separately. [http://www.ncbi.nlm.nih.gov/books/NBK3885/]
* **Sustained attention** refers to the ability to maintain concentration on a task over an extended period. [http://www.ncbi.nlm.nih.gov/books/NBK3885/]

**4.1.3 Abstraction**[**§**](http://www.w3.org/TR/coga-user-research/#abstraction)

Types of abstraction include:

* essentialism
* object recognition - Abstraction is part of visual comprehension
* face recognition (seems to be separate from object recognition)
* facial patterns (such as an angry face)
* linguistical abstractions (such as relations between syntax, semantics, and pragmatics.)
* quantities
* numerical concepts
* abstract context of time
* spatial orientation, directions, layout of things.
* mechanical abstractions
* musical abstractions
* behavioral and social abstractions –
  + norms, etc
  + social cues
  + other behavioral:

**4.2 Memory**[**§**](http://www.w3.org/TR/coga-user-research/#memory-2)

People talk about types of memories are often talking about different categories of types of memory. Any memory-based events can be described in all these categories. For example: an event may cause a sensory experience to go into long-term memory implicitly. Here are the types we have identified:

* **durationbased:** working, long term, short term, and possibly intermediary
* **context based:** emotional, procedural, sensory (tactile, smell, psychomotor, kinesthetic, olfactory, auditory, visual, visuo-spatial, spatial, musical, and prospective memory.
* **awareness level**: implicit and explicit

**4.2.1 Duration Based**[**§**](http://www.w3.org/TR/coga-user-research/#duration-based)

* **Working memory** involves mentally manipulating — is the system that actively holds multiple pieces of transitory information in the mind, where they can be manipulated. [[1]](http://en.wikipedia.org/wiki/Working_memory#cite_note-Cowan-1) Baddeley and Hitch feel it is executive and attention control of short-term memory, but others point out that long term memory can also be involved in working memory.
* **Short-term memory** (also called active or primary memory) typically lasts seconds, such as remembering the phone number while you find a pen and write it down. Subtypes are Verbal, Visual, and Spatial. Four different units in short-term memory are probably average. Capacity of short-term memory is often called memory span.
* **Long-term memory** (also called reference memory, long-term storage and retrieval (Glr),TSR, Glm), the ability to store and consolidate new information in memory and later fluently retrieve stored information. Broad retrieval ability (G) is a related idea.

**4.2.2 Context Based**[**§**](http://www.w3.org/TR/coga-user-research/#context-based)

* **Episodic memory** (autobiographical – time, self)
* **Semantic** memory (factual)
* **Visual memory**
* **Visuo-spatial memory**
* **Spatial memory**
* **Musical memory**
* **Auditory memory:** Memory for sound patterns (UM)
* **Procedural memory:** Memory for performance of particular types of action such as walking.
* **Prospective memory**: Much of what we have to remember in everyday life involves prospective memory — remembering to do things in the future, such as keep appointments, return a book to the library, or pay bills on time. [http://www.ncbi.nlm.nih.gov/books/NBK3885/]
* **Emotional memories:** can be both declarative- and procedural-memory processes.

**4.2.3 Awareness Based**[**§**](http://www.w3.org/TR/coga-user-research/#awareness-based)

* **Implicit memory**: (Can be called non-declarative memory) is built or used without conscious awareness. In contrast with...
* **Explicit memory**: (Can be called declarative memory) the intentional use of memory such as remembering the time of an appointment or studying for an exam.

Also, memories can be stored and recalled as **Associative Memory** (AM), **Meaningful memory**(MM), **Free-recall memory** (M6),

**4.3 Language**[**§**](http://www.w3.org/TR/coga-user-research/#language)

Speak, write, read, or understand speech and/or language.

**4.3.1 Spoken Languages**[**§**](http://www.w3.org/TR/coga-user-research/#spoken-languages)

The basic skills for spoken languages seem to be **speech perception**. Speech perception is when sounds of language are heard, interpreted, and understood. This depends upon:

* Auditory Discrimination (Note: not loss of hearing, but identification and differentiation of sounds, also called General sound discrimination (U3)
* Temporal Tracking (UK)
* Listening Ability (LS)
* Naming skills (N)
* Related memory such as Working Memory, auditory memory - (Memory for sound patterns)
* Morphosyntax: The system of the internal structure of words (morphology) and the way in which words are put together to form phrases and sentences (syntax).
* Understanding figural language, including a simile (a comparison of two things, such as “His cheeks were like roses”; a metaphor; onomatopoeia (a word designed to be an imitation of a sound such as “Bark! Bark!”); personification (attribution of a personal nature to inanimate objects); an oxymoron (opposite or contradictory terms are used together for emphasis, such as “organized chaos”); a paradox;a hyperbole (an extreme exaggeration, such as “I was so upset I nearly died”); allusion; or idiom, such as "You should keep your eye out for him"); and puns.

Note

Spoken language also requires an ability to produce voice

**4.3.2 Sign Language**[**§**](http://www.w3.org/TR/coga-user-research/#sign-language)

Sign language, without spoken language, probably requires a slightly-different set of skills, such as:

* Visual Recognition Skills
* Non-vocal Naming - Association of sign and concept
* Phoneme Processing and Phonetic coding (PC)
* Related memory, such as Working Memory, Visual memory, Memory for patterns
* Morphosyntax: The system of the internal structure of words (morphology) and the way in which words are put together to form phrases and sentences (syntax).
* Understanding figural language.

**4.3.3 Literacy**[**§**](http://www.w3.org/TR/coga-user-research/#literacy-2)

Beyond basic language, literacy typically requires:

* Visual Recognition (see below)
* Visual memory (not affected in Down Syndrome)
* Phoneme Processing and Phonetic coding (PC)
* Cross-modal Association of sign and concept

Note that many people with dyslexia achieve literacy without many of these functions, or with impaired functioning.

**4.4 Perception**[**§**](http://www.w3.org/TR/coga-user-research/#perception)

**4.4.1 Visual Recognition (Also called visual perception)[§](http://www.w3.org/TR/coga-user-research/" \l "visual-recognition-also-called-visual-perception" \o "Permalink for visual-recognition-also-called-visual-perception)**

The visual system automatically groups elements into patterns: Proximity, Similarity, Closure, Symmetry, Common Fate (i.e., common motion), and Continuity (Gestalt psychology).

Functions include:

* object recognition
* face recognition (seems to be a different process from object recognition [Face and object recognition ((Alex Huk. (1999) "Object and Face Recognition: Lecture Notes." pp. 5]
* Pattern Recognition

**4.4.2 Other Perception**[**§**](http://www.w3.org/TR/coga-user-research/#other-perception)

Auditory perception (see Speech perception above for further classifications), Motor, Tactile, Psychomotor, Kinesthetic (body position, weight, or movement), Olfactory and sensory perception.

**4.5 Speed**[**§**](http://www.w3.org/TR/coga-user-research/#speed)

Processing speed affect all functions above. See Caroll. A related concept is **fluency**

**4.6 Knowledge**[**§**](http://www.w3.org/TR/coga-user-research/#knowledge)

Types of knowledge that might be required for use of Web content include:

* knowledge of culture
* base Language knowledge, including:
* lexical (UL)
* jargon (subject matter)
* Web jargon and technology
* Web and technology usages and risks
* metaphors and idioms
* icons and symbols
* mathematical knowledge
* mechanical Knowledge (MK)
* knowledge of behaviors
* design metaphor – look
* design functions

**4.7 Not (Yet) Fully Addressed:**[**§**](http://www.w3.org/TR/coga-user-research/#not-yet-fully-addressed)

* consciousness
* identity
* emotions (such as fear), moods, and motivations
* libido and sexual function
* creative thought
* personality
* judgment and self-monitoring
* initiative
* inhibition

Note that these are in our mandate. For example: Dementia with Lewy bodies affects the cerebrum, where small round lumps of proteins build up and can cause fluctuations of consciousness, as well as hallucinations, delusions (firmly held beliefs in things that are not real), and false ideas (such as with paranoia).

**4.8 Areas of the Brain**[**§**](http://www.w3.org/TR/coga-user-research/#areas-of-the-brain)

This section summaries functions of different areas of the brain. See <http://www.md-health.com/Parts-Of-The-Brain-And-Function.html> and http://www.enchantedlearning.com/subjects/anatomy/brain/Structure.shtml.

**Frontal Lobe**

* reasoning and problem solving
* initiative, inhibition, and behavior
* abstractions
* attention
* creative thought
* some emotion
* reflection
* judgment
* coordination of movements
* generalized and mass movements
* skilled movements and some motor skills
* libido (sexual urges)

**Occipital Lobe**

* vision
* **Broca's Area** controls facial neurons as well as understanding of speech and language.

**Parietal Lobe**

* tactile sensation
* appreciation of form through touch (stereognosis)
* response to internal stimuli (proprioception)
* sensory combination and comprehension
* some language and reading functions
* some visual functions

**Temporal Lobe**

* some hearing
* memory, including auditory memories and visual memories
* music
* some behavior and emotions, such as fear
* sense of identity
* **Wernicke's Area**- This portion of the temporal lobe is formed around the auditory cortex. Formulate or understand speech.

**Limbic System**

The limbic system contains glands, which help relay emotions.

* **Amygdala:** The amygdala helps the body respond to emotions, memories and fear.
* **Hippocampus**: Used for explicit memory, specifically converting temporary memories into permanent memories, which can be stored within the brain. The hippocampus also helps people analyze and remember spatial relationships, enabling accurate movements.
* **Hypothalamus**: mood, thirst, hunger, and temperature.
* **Thalamus**: attention span, sensing pain, and tracking of sensations the body is feeling.

**Corpus Callosum**

* communication between the left and the right sides of the brain

**Cerebellum**

* balance and posture
* cardiac, respiratory, and vasomotor centers

**Brain Stem**

* Motor and sensory pathway to body and face
* Vital centers: cardiac, respiratory, vasomotor

**Pituitary Gland**

* hormonal body processes
* physical maturation
* growth (height and form)
* sexual maturation
* sexual functioning

**4.9 Sources on Cognitive Functions**[**§**](http://www.w3.org/TR/coga-user-research/#sources-on-cognitive-functions)

1. Educational taxonomies, such as Carol for Cyristalised resing, includes:

* Language Development
* Lexical Knowledge (VL)
* Listening Ability(LS)
* General (verbal) Information (K0)
* Range of general stored knowledge (primarily verbal)
* Information about Culture (K2)
* Range of stored general cultural knowledge (e.g., music, art)
* Communication Ability (CM)
* Oral Production and Fluency (OP)
* Grammatical Sensitivity (MY)
* Morphology and sentences (syntax)
* Foreign Language Proficiency (KL)
* Foreign Language Aptitude (LA)

2. Inappropriate behavior is common with Frontotemporal dementia - impaired social interaction.

Affected in: Alzheimer’s disease, Aphasias, Advanced age, dyslexia, emotional disabilities such as Schizophrenia and PTSD

4. Expressive aphasia left inferior frontal cortex. These people are described with having severe syntactical deficits, which means they have extreme difficulty in forming sentences correctly. Hessler, Dorte; Jonkers, Bastiaanse (December 2010). "The influence of phonetic dimensions on aphasic speech perception". Clinical Linguistics and Phonetics. 12 24: 980–996.

5. Receptive aphasia - left temproparietal lobe. People with Receptive Aphasic mostly suffer from lexical-semantic difficulties, but also have difficulties in comprehension tasks. The effect of receptive aphasia on understanding is much more severe. Hessler, Dorte; Jonkers, Bastiaanse (December 2010). "The influence of phonetic dimensions on aphasic speech perception". Clinical Linguistics and Phonetics. 12 24: 980–996.

Anarthria: Loss of the motor ability that enables speech. Complete loss of the ability to vocalize words as a result of an injury to the part of the brain responsible for controlling the larynx.

Aphonia: The inability to produce voice.

Alalia: A delay in the development or use of the mechanisms that produce speech.

Dyslalia: Difficulties in talking due to structural defects in speech organs.

Developmental verbal dyspraxia: Motor speech disorder involving impairments in the motor control of speech production.

6. Carol tends to have abilites as the main category with memory and sensitivity, such as tactile sensitivity (other than psychomotor abilities, which have subcategories of static strength (P3), multi-limb coordination (P6), finger dexterity (P2), manual dexterity (P1), arm-hand steadiness (P7), sontrol precision (P8), aiming (A1), gross-body equilibrium (P4)

7. Carol brings Processing speed (Gs), such as cognitive processing speed (Gs), broad-cognitive speediness (Gs), perceptual speed (P), rate-of-test-taking (R9), number facility (N), speed of reasoning (RE), reading speed (RS), writing speed (WS), reaction and decision Speed (Gt), correct decision speed (CDS), processing speed, (RT) decision speed (such as simple-reaction time) (R1), choice reaction time (R2), semantic processing speed (R4), mental-comparison speed (R7), inspection time (IT)

8. Carol brings Ideational Fluency (FI), Associational Fluency (FA), Expressional Fluency (FE), Word Fluency (FW), Figural Fluency (FF), Figural Flexibility (FX), Sensitivity to Problems (SP), Originality/Creativity Fluency (FO), Learning Abilities (L1), Naming Facility (N)

**5. Methodology in User Research**[**§**](http://www.w3.org/TR/coga-user-research/#methodology-in-user-research)

In making user scenarios and user group research, we took a multilevel approach including:

**5.1 Asking Users**[**§**](http://www.w3.org/TR/coga-user-research/#asking-users)

1. What do they have trouble with?
2. What tasks do they need help with?
3. What tasks they avoid?
4. What tasks often lead to mistakes?

**5.2 Addressing Specific Topics**[**§**](http://www.w3.org/TR/coga-user-research/#addressing-specific-topics)

In the user group research section of the gap analysis, we aim to identify abstract principles for accessibility for people with cognitive and learning disabilities; core challenges for each user group; as well as practical techniques.

However, when trying to identify abstract principles, it is often helpful to look at concrete-user scenarios and challenges that different user groups face. For that purpose, we have identified practical and diverse user scenarios that should be considered in user-group research. These include:

**5.2.1 Communication**[**§**](http://www.w3.org/TR/coga-user-research/#communication)

Making sure users can communicate with people and be part of society. Tasks to investigate:

1. use email and chat effectively
2. be aware of a change
3. share pictures and information
4. play
5. request information

**5.2.2 Applications**[**§**](http://www.w3.org/TR/coga-user-research/#applications)

1. Apps to enable work, such as document authoring
2. Critical DHTML content and applications such as: enroll and manage healthcare; make an appointment; enroll and manage banking; shop online.
3. sign-up / register and manage account profile on a site; book and manage travel
4. enroll in and participate in online education
5. apps such as mobile apps
6. directions / locations

**5.2.3 Web of Things and Web Systems**[**§**](http://www.w3.org/TR/coga-user-research/#web-of-things-and-web-systems)

1. Use Web of Things applications, such as temperature control, entertainment systems
2. phone-menu systems
3. other menu systems

**5.2.4 Research and Education**[**§**](http://www.w3.org/TR/coga-user-research/#research-and-education)

1. Understand content and learning material.
2. Search, research, and find information.
3. Enroll in and participate in online education.

**5.2.5 Access to Critical Information**[**§**](http://www.w3.org/TR/coga-user-research/#access-to-critical-information)

1. Read and share news.
2. Find weather alerts.
3. Find and read emergency information.
4. Find out rights and social-service information.

**5.3 Cross-Cutting Concerns**[**§**](http://www.w3.org/TR/coga-user-research/#cross-cutting-concerns)

Using content should be:

1. safe
2. effective
3. minimally-frustrating

**6. Potential for Inclusion**[**§**](http://www.w3.org/TR/coga-user-research/#potential-for-inclusion)

**6.1 Proposed Directions**[**§**](http://www.w3.org/TR/coga-user-research/#proposed-directions)

The aim of the Cognitive and Learning Disabilities Accessibility Task Force (COGA) is to improve Web accessibility for people with cognitive and learning disabilities.

This is a background-research document. However, it may be worth concluding with an overview of what could be done for accessibility for people with cognitive and learning disabilities. It is intended to help us (COGA) identify what needs to be done to get there.

Note

Note that some of the ideas below may be out of scope for our mandate and role as a W3C task force.

**6.1.1 What is Needed**[**§**](http://www.w3.org/TR/coga-user-research/#what-is-needed)

**6.1.2 Techniques for Everyone**[**§**](http://www.w3.org/TR/coga-user-research/#techniques-for-everyone)

A substantial amount of techniques are helpful  for over 90% of people with cognitive disabilities. These techniques need to be gathered in one place.

For example, most people with any cognitive disability may be disturbed when form data is lost when a session times out. Almost all user groups may need help or  need to double check data entered into a form. Timing out so they need to start again may make a form unusable.

See [sample technique format](http://w3c.github.io/coga/templates/technique-template.html) to help us gather techniques as we come across them, so that they do not get forgotten or are hard to find later when we are finished the gap analysis.

**6.1.3 Techniques for User Groups**[**§**](http://www.w3.org/TR/coga-user-research/#techniques-for-user-groups)

We also need to document techniques good for some user groups and not for others (depends upon cognitive function and localization). For example, text under symbols may be useful for many people with dementia, but unhelpful for many people with severe language disabilities.

In a localization example using left-hand-side text, alignment is helpful for  English sites, but right-hand-side text alignment is  helpful for sites in Arabic or Hebrew.

See [sample page structure and more examples](http://accessibility.athena-ict.com/TechniquesCOGA.html).

**6.1.4 Grouping Techniques**[**§**](http://www.w3.org/TR/coga-user-research/#grouping-techniques)

Once we have a comprehensive set of techniques,  we may want to group techniques  into “enhancements”. For example, we may make a group of techniques as “simple text” enhancements for easier reference.

We may also want to identify how different enhancements benefit people with different limitations of cognitive functions.

To achieve this, we may need to label groups of cognitive functions, so that we can simplify linking enhancements to cognitive functions. See [an initial page of cognitive function](http://accessibility.athena-ict.com/cognativefunction.shtml).

Once we have a set of enhancements, we can enable standards, such as EARL, to identify  which documents support which enhancements. Other supported systems include GPII, ISO, Cloud4all, and possibly FLUID.

Once we have a comprehensive set of techniques, we can also explore what is needed to make a website adaptable to different groups of users.  We may be able to identify semantics that enable adaptation for specific learning and cognitive disabilities; and to conflicting needs of different users.

This could include:

* adaptive text: This would enable text to become simpler or more literal or adapt to the user needs.
* adaptive components: There are many ways to make the same widget. Because different web sites implement the same functions differently, the user needs to learn how to interact and use them with specific-page widgets. Adaptive components would enable the user to use one interface, which they know how to use, across many different sites.
* adaptive pages: This would enable changing or adapting the page layout, cutting out extra features or confusing aspects of the page. This would add semantics to enable adaptive interfaces and AT. This would enable adaptive interfaces to allow users to use complex interfaces via an independent and familiar interface tailored to their scenarios and strengths. As this interface is designed for the user/user group, all features are familiar, and the same buttons and metaphors will be used across all conformant applications.
* adaptive media
* adaptive forms and billing: This may result in suggestions to ARIA 2.0  and PF for additional semantics to enable AT to provide techniques.

(See [more information about making adaptable content for people with cognitive disabilities](http://accessibility.athena-ict.com/cognitive/adaptable1.html))

This may result in suggestions  to PF group for the ARIA 2.0 specification.

**6.1.5 Special Projects**[**§**](http://www.w3.org/TR/coga-user-research/#special-projects)

There may be other accommodations needed that are outside the handshaking approach or adaptable pages.

* Accessible -menu systems for people with  cognitive disabilities: This will look at what measures or techniques  could make phone menu systems usable by for people with  cognitive disabilities, such as enabling people to reach an operator.  (Relevant specification: voice Ml)
* Interoperable AAC symbols AND
* Lexicon and symbols that support low literacy.
* Labels for cognitive function: See [an early draft](http://accessibility.athena-ict.com/cognativefunction.shtml).

Also see [more ideas](https://www.w3.org/WAI/PF/cognitive-a11y-tf/wiki/Section_3).

**A. Acknowledgments**[**§**](http://www.w3.org/TR/coga-user-research/#acknowledgements)

*This section is non-normative.*

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