Drafting standards on cognitive accessibility: a global collaboration

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ARTICLE HISTORY

Received 13 November 2015, Revised 5 April 2016, Accepted 5 April 2016, Published online ???

Abstract:

Purpose

The International Organization for Standardization (ISO) is working on accessibility of products to support people with cognitive impairment. Working Group 10, within the Technical Committee 173 (Assistive products for persons with disability) was formed in 2014 to draft standards for assistive products that support people with cognitive impairment.

Method

This paper explains the scope and purpose of the working group and the context for its formation, and describes the plans and process for drafting and publishing new international standards.

Results

The proposed suite of standards is presented, with examples from a proposed standard on daily time management. It draws on international research evidence for the effectiveness of assistive products designed to support time management in people with cognitive impairment. Examples of assistive products and their key features are provided based on domains of time as defined in the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY).

Conclusions

The proposed standards will provide design recommendations for features and functions that increase the accessibility of products used by people with cognitive impairment. It is intended to be

used by designers, manufactures, educators and services providers, to facilitate their commitment to inclusion and demonstrate their willingness to work with accessibility regulation.

Key words:

Accessibility, usability, cognition, International Organisation for Standardization (ISO), assistive technology, time management, ICF-CY

Implications for rehabilitation

- New standards based on universal design principles can guide the design of more user-friendly assistive products for people with cognitive impairment.
- Greater usability of assistive products, whether mainstream or specially-designed, will make it easier for practitioners to find and introduce assistive solutions to individuals with cognitive impairment.
- Greater usability of assistive products for daily time management can decrease the need for user training and support and enable participation.

Introduction

Accessibility, inclusion and respect for diversity are highlighted in the *General Principles* (Article 3) of the Convention on the Rights of Persons with Disability (CRPD), and the promotion of research and development into universal design listed in the *General Obligations* (Article 4) [1]. The World Report on Disability highlighted the barriers to full participation in society and unmet needs of more than one billion people living with disability [2]. Ageing populations contribute significantly to the increasing and accelerating global prevalence of disability, particularly through people living with dementia, estimated by the World Health Organisation (WHO) to be 35.6 million in 2010 [3]. This landmark report presents recommendations for action on disability as a health and human rights issue, with potential economic benefits for states that address inclusion through systemic action across all sectors.

Early legislation, standards and guidance for accessibility focused on the design of public buildings and mainstream products to meet the needs of people with physical impairment, particularly wheelchair users. While the scope has been extended to consider people with sensory impairment (particularly hearing or seeing), there has been less advocacy and research to guide design for people with cognitive impairment, whether it is the result of developmental delay, acquired brain

injury or neurological conditions such as dementia. Within the diversity of disability experiences, people with cognitive impairment are more marginalised than most in society, with the lowest rates of workforce participation [2].

ISO/DIS 9999 defines an assistive product as any product (including devices, equipment, instruments and software), especially produced or generally available, used by or for persons with disability: for participation; to protect, support, train, measure or substitute for body functions/structures and activities; or to prevent impairments, activity limitations or participation restrictions [4]. Mainstream products are often considered to be more affordable and socially acceptable than those especially produced for people with disability, so there is increasing interest in their application as cognitive supports. Limited access to mainstream products, including information technologies, contributes to exclusion of people with cognitive impairment, particularly in societies where people use these to communicate, organise and negotiate their working, social and recreational lives [5]. Even when access is no barrier, user interfaces on phones and other mainstream products that are confusing or not adapted to individual users' needs and preferences limit their adoption and effective use. In effect, the digital environment creates demands that can threaten people's sense of competence and restrict their participation [6] Designers and manufacturers of mainstream products are often not aware of the needs of older people and people with disability, or of design strategies that help meet their needs [7]. The adoption of universal design (UD) approaches in standards and policies is key to the World Report on Disability's first recommendation; to facilitate access to mainstream systems and services [2].

This has led the member bodies of the ISO Technical Committee 173 to commence preliminary work on accessibility which is anticipated to result in the drafting of a standard, *Assistive products for persons with disability— Basic Principles and General Guidelines on Cognitive Accessibility* and accompanying standards related to specific activities, such as daily time management, money management and indoor navigation. This work represents a collaborative response to improve access to mainstream systems and services as recommended by the WHO, and as an obligation of states that have ratified the CRPD. Adoption of UD principles to improve accessibility is also consistent with a number of national legislations and policies. For example, UD is seen as a helpful approach for service providers to meet the provisions of *Section 508 of the US Rehabilitation Act*, requiring electronic and information technology developed, maintained, procured, or used by the federal government to be accessible to employees and the general public. The adoption of the ISO 9999 definition of assistive product is intentional, to ensure that accessibility and universal design are considered both in specially produced and generally available products. This paper describes the

rationale for developing new international standards on cognitive accessibility, and the process of progressing this collaborative work.

Formation and membership of Working Group 10: assistive products for cognitive disabilities

International support for disability rights, as demonstrated through the ratifications of the CRPD [8] has resulted in greater recognition of the needs of people with developmental and intellectual impairment, and ageing populations. Research has demonstrated improvements in self-efficacy and general health for people who use assistive technologies (AT) for cognition, and highlighted the importance of support from professionals and social networks in the adoption of AT for cognition [9-12].

In 2010, the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) formed a Standards committee on Cognitive Technologies, led by researchers from the Rehabilitation Engineering Research Center (RERC) for the Advancement of Cognitive Technologies working on a project titled "Development of Uniform Standards for Cognitive Technologies". RESNA is a standards developing organization accredited by the American National Standards Institute (ANSI) and Technical Advisory Group to ANSI for the development of ISO Standards (International Organization for Standardization) pertaining to assistive products for people with disability. Parallel to this, a European Standard (EN 121 82) was published, with guidance on design for people with cognitive impairment.

In Sweden, Funka's 'Begripsam' (roughly translated as 'understandability') project began in 2008, with the aim of developing methods for people with cognitive and mental impairments (including ASD, ADHD, mild intellectual disability, bipolar and dyslexia) to participate in research and development, and empowering them to influence design for a less complicated world [13]. End users' preferences for web content were investigated first, by testing content presented in variety of formats including plain language text, photos, illustrations, audio, animation and video. The researchers have explored a range of methodologies for developing and evaluating products and services (including surveys, focus groups, storytelling, and eye gaze tracking), focusing on the cognitive and linguistic aspects of accessibility.

Members of RESNA and Funka came together with representatives from several other nations (Japan, Australia, Denmark and Israel) and institutions, including the European Association for the Co-ordination of Consumer Representation in Standardisation (ANEC) and the European Telecommunications Standards Institute (ETSI). The working group has a chair and secretariat, and various members lead the drafting of documents based on their expertise and according to the ISO

standards development process [14]. The working group meets regularly online and face-to-face, and shares a virtual space (ISO Hub) for reference documents and drafts, and members report back to mirror committees in some nations (e.g. Standards Australia committee ME-067).

Promotion and collaboration are regarded by the working group members as necessary for successful creation and use of this proposed standard. As a normative document, a technical specification (TS) represents the consensus within an ISO committee. It is subject to voting and approval by at least 75% of the national bodies who are members of the committee before being published, and has provision for review before being converted into an international standard (IS). Comments from members will be used to prepare Committee Drafts (CD) of two standards in 2016; one providing general guidance on cognitive accessibility, and the other focuses on cognitive accessibility for daily time management.

Content and objectives of the cognitive accessibility standard

Accessibility standards and guidance have been criticised for operationalising environmental dimensions (e.g. time, distance) without relating them to interactions with a diversity of users [15]. A recent systematic review highlighted the diverse accessibility needs and preferences of people with cognitive impairment, and the need for guidelines and standards that reflect this by promoting adaptability rather than conformity [16]. The cognitive accessibility standards therefore aim to avoid prescriptive rules, instead providing principles and strategies, consistent with a UD approach, which promotes features in the built environment that are functional and comfortable for everyone [17]. At the broadest level, *ISO 26800:2011 -- Ergonomics -- General approach, principles and concepts* identifies a general approach and principles relevant to the design and evaluation of interactive systems [18]. ISO 26800 defines accessibility as the "extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use". The new standards adopt this but further specifies cognitive accessibility as "the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of cognitive characteristics and abilities to achieve a specified goal in a specified context of use".

Although termed cognitive 'accessibility', the standards will also adopt the concept of 'usability' to ensure that design principles are based on the unique experiences of users rather than on assumptions of human abilities. ISO 9241 (Ergonomics of human-system interaction) defines usability as "the effectiveness, efficiency and satisfaction with which specified users achieve

specified goals in particular environments" [19]. Usability is necessarily a more individual and subjective assessment than accessibility, incorporating psychosocial factors and perceptions of how well an environment enables participation and inclusion [15,20]. Usability functions as a framework for specifying design goals and evaluating their achievement. For example, the concept of orientation to time is taken from the ICF-CY (b1140) and translated into a list of user needs, such as "to know whether it is an appropriate time of day or night for particular activities". One of the design recommendations to address this need is to "provide options for representing different time concepts" with the suggested use and examples of symbols, colours, text, characters or numbers.

The cognitive accessibility standards sit within a network of existing ISO guidance on accessibility and usability. The aim is for the cognitive accessibility standards to be used by designers, manufactures, educators and services providers, to demonstrate their commitment to inclusion and willingness to work with accessibility regulation. Although most people involved in standardisation do not have embedded strategies for accessibility in design and manufacturing, many have expressed an intention to increase their knowledge to meet the needs of consumers who are older and living with disability [7]. The standards will refer to several documents, including the World Health Organisation's (WHO) International Classification on Functioning Disability and Health (ICF) [21], and the European Standards on information supplied by the manufacturer of medical devices (EN 1041) and preparation of instructions – structuring, content and presentation (EN 62079), and *ISO/IEC Guide 71:2014 Guide for addressing accessibility in standards* [22].

First published in 2001 and then revised, Guide 71 provides standards developers with information and strategies for accessibility in standards for any type of system that people use. Additional standards have been written to supplement Guide 71 by providing guidance on specific product or service sectors, for *example ISO/IEC TR 29138-1:2009 Information technology -- Accessibility considerations for people with disabilities -- Part 1: User needs summary* , and *ISO/TS 16071:2003 Ergonomics of human-system interaction -- Guidance on accessibility for human-computer interfaces* [23]. Other standards refer back to Guide 71, for example in Europe *CEN/CENELEC Guide 11 (2011): Product information relevant to consumers – Guidelines for standard developers* refers back for guidance on informational needs of people with disabilities and older people.

The new standards will build on Section 7.5 of Guide 71, provide principles of cognitive accessibility, followed by guidelines for their application in design in greater detail than Guide 71's 'design considerations' (Section 7.5.3). They will focus on identifying the critical variables in the design and construction of products (and common exceptions) that affect their usability for people with cognitive impairment. A standard describing test methods will provide specific instructions for measuring and reporting on these variables, to provide relevant product information about intended

use and users to potential vendors and consumers. As an example, the remainder of this paper describes and provides excerpts from one of the proposed standards: Assistive products for persons with disability— Guidelines on cognitive accessibility for daily time management.

Proposed standard: Assistive products for persons with disability— Guidelines on cognitive accessibility for daily time management

How we use and manage our time is of great importance for daily life including employment and other domains of participation, and well-being [24,25]. Time management behaviours relate positively to perceived control of time, job satisfaction and health, and negatively to stress [26]. Children, adolescents and adults living with various types of cognitive impairment (e.g. ADHD, Autism spectrum disorders, schizophrenia, psychosis, depression and intellectual disability) may experience problems with daily time management [27-32]. Age-related cognitive impairments, such as those associated with dementia, may also precipitate a need for support in daily time management [33].The time-dependent society of today places high demands on each citizen. People with limited ability to manage time show a heightened dependence on others and greater need for support, exacerbating their inferior status and vulnerability.

Rationale for use of assistive products to support daily time management

There is strong evidence for the effectiveness of assistive products in daily time management by people with cognitive impairment (e.g. a reminder system for adults with acquired brain injury) [6,12]. Assistive products for daily time management include both mainstream products such as smartphones or alarm clocks, and products designed specifically for people with cognitive impairment. Use of assistive products can compensate for a lack of time management skills, and support people in improving or maintaining independence and participation [6,9,10,34]. Importantly, even basic and mainstream products can give people with cognitive impairment a sense of control and opportunity to demonstrate their capacity and competence to others who may judge them [6].

It is also acknowledged that assistive products are not always used as intended, and that non-use is frequently associated with a loss of independence at an individual level and with inefficient allocation of resources at a societal level [35]. People with cognitive impairment and limited time-processing abilities who find assistive products such as electronic planning devices (EPDs) beneficial tend to use them [11,36], however their use is influenced by environmental factors, including support from professionals and services [37]. Well-designed EPDs that are matched to the individual user's needs (i.e. greater usability of assistive products) are associated with greater user

independence. Research has also highlighted the necessity of adaptation of EPDs to individual users, regardless whether they are mainstream or specially-designed products [11]. Therefore, the more that producers of assistive products for daily time management consider making the products easy to understand, easy to manage and motivating (i.e. usable), the greater the benefits to individual users and society.

Key concepts and terms in the proposed standard

The proposed standard adopts concepts of time from the International Classification of Functioning, Disability and Health, Children & Youth Version (ICF-CY) [38]. Experience of time and time perception [b1802] are the specific mental functions of the subjective experiences related to the length and passage of time and perceiving the duration of activities. Orientation to time [b1140] comprises the general mental functions that produce awareness of today, tomorrow, and yesterday, as well as the date, month and year [b1140]. The higher-level cognitive functions of time management [b1642] are defined as ordering events in chronological sequence, allocating amounts of time to events and activities and, as a superordinate concept, part of executive functions. These three concepts are considered within the body functions component of ICF-CY, and can be summated into time-processing ability [39], as distinct from "managing one's time" in daily life [d2305] and "adapting to time demands" [d2306]. Managing one's time is defined as managing the time required to complete usual or specific activities, such as preparing to depart from the home and taking medications, as part of daily routine [d230]. These are classified within the component of 'activities and participation' in the ICF-CY (and ICF), and can be considered as complementary aspects of "daily time management" [40]. Assistive products to compensate for a lack of time-processing ability aim to facilitate daily time management.

The proposed standard will provide design recommendations for features and functions known to increase the accessibility of products and systems used to support daily time management for people with cognitive impairment. It is structured according to time-processing abilities, namely: perception of time, orientation in time, time management, and adapting to time demands. These abilities are defined and illustrated with examples that demonstrate possible solutions (and their outcomes) to meet user needs. The following are excerpts from the draft proposed standard:

Assistive products for low levels of time-processing ability, time perception

The 'quarter hour principle' for compensation of time perception facilitated the development of time aids (assistive products), making the passage of time visible and understandable. One example of a time aid built on this principle is the Time Log, which has a row of light diodes. The passage of time is made visible by all diodes starting lit, to indicate a long time, with a decrease in the number

of lit diodes, so that only a few indicate a short time [41]. These types of assistive products are fairly new but have been evaluated in several studies [34,42].

Assistive products for medium levels of time-processing ability, time orientation

Compensatory interventions to support orientation in time include the use of calendars, picture books, Quarter-hour watch, adapted calendars and other visual aids to promote orientation to the time of the day, week, or year [43]. Assistive products with pictures presenting daily activities in time order are well established for supporting children with autism, as a means to providing an organized and predictable environment [44,45], and are also used for individuals with severe intellectual impairment.

Assistive products for high levels of time-processing ability, time management

Interventions to promote, develop and/or compensate for deficits in time management focus on self-scheduling skills. Self-management interventions may include the introduction of low-tech time aids (e.g. and adapted Filofax), and high-tech time aids (e.g. software for a handheld PC or apps for a smartphone).

Conclusion

This paper has described the ISO project to draft new standards on accessibility of products used by people with cognitive impairment. The scope and purpose of the project has been outlined, with excerpts from a draft standard on cognitive accessibility for daily time management. International research into the effectiveness of assistive products for people with cognitive impairment, along with published guidance on accessibility and the terminology of the ICF-CY inform the standard. The concepts of accessibility and usability, and principles of universal design are critical for the provision of guidance and test methods that promote design for adaptability rather than conformity to prescriptive rules. The proposed standards will provide design strategies to meet the needs of people with cognitive impairment regardless of age.

Acknowledgments

The authors gratefully acknowledge the contributions of members of the ISO Technical Committee 173 Working Group 10. The authors also acknowledge our colleagues who live with cognitive impairment and processing differences, for their collaboration and support that enables us to progress this work with an appreciation of diversity in cognition and participation.

Declaration of Interest statement

The authors report no declarations of interest.

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