

PGA: Preferences for Global Access

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Abstract. This paper highlights the research for year one of the Preferences for Global Access (PGA) project whose long term goal is to define a cross-platform preference acquisition system to acquire a user's needs and preferences for accessing Information and Communication Technology (ICT) as part of a cloud-based Global Public Inclusive Infrastructure (GPII).

Keywords: accessibility cloud GPII inclusive.

1 Background and Need

Each year, our daily activities are increasingly mediated in some way by digital technologies -- from point-of-sale devices, to self-service kiosks, to Internet-based services, to name a few. Access to these technologies has gone from optional to essential as more traditional ways of doing things are replaced with devices having digital interfaces: Agents are becoming kiosks, books are becoming eBooks, and parking meters are becoming digital fare stations. As such, the ability to use digital technologies is all but required for full participation in commercial, cultural, recreational and social activities. Yet today, millions of people are not able to access these technologies.

While there have been advances in accessibility features embedded in native platforms and websites, and while advocacy toward accessible user interfaces and content design continues, most applications and products are designed as one-size-fits-all solutions. For example, if users are blind pictures are replaced with text, and if users do not use a mouse, keyboard navigation is activated. This approach fails to recognize the heterogeneity of individuals and the different contexts they operate. Access issues arise for multiple reasons, including breakdowns between the technology's interface and a user's ability to engage with it, and compatibility of access solutions with a

user's device or with a user's context or setting. Additionally a user's functional disability may be temporary or permanent, stable or progressive. This means that a user may have shifting needs over time that move within or between certain diagnoses. In sum, accessibility solutions designed for people with a specific disability diagnosis are not fully inclusive, and only provide support for individuals whose problems can be described as "typical" for that diagnosis. The result has been a limited set of solutions that work for some, but exclude many.

The predominant one-size-fits-all approaches not only affect the "goodness of fit" and thereby effectiveness of the solutions, but also remove the ability of individuals to control the interfaces they must use. Whether embedded in the design of products or services, or embodied in the clinical interventions that arrogate such decisions to certified authorities, current solutions potentially deny agency—the sense of autonomy made concrete by action—to users. In doing so, these solutions can serve to disempower the person who is theoretically best positioned to make his or her own personalization decisions and to learn from those decisions.

The result of factors such as these is that many users are dissatisfied with their assistive technology (AT) systems (Hastings Kraskowsky & Finlayson, 2001), and many report underutilizing or abandoning their systems altogether (Reimer-Weiss & Wacker, 2000). In attempting to mitigate these factors, this project seeks to replace a one-size-fits-all, "inoculation model" of accessibility—one assessment and prescription for all time—with an approach that is more accurately developmental and attuned to technological churn. We seek to enable users with sensory or physical limitations, cognitive constraints, unique learning affordances, or other barriers to discover and articulate their needs and preferences for specific contexts, in an unobtrusive yet helpful way. Enabling users to explore preferences and to learn how to improve their experience with technology can have a significant impact on users' ability to remove the barriers to access that they experience.

2 PGA Project Objectives

The PGA project is a multi-year project. Within the scope of this project, preferences are defined as functional descriptions of how users prefer to have information presented, how they wish to control any function in the technology application, and settings or commands that are stored (or that will be stored) for them. Preference sets are groups of preferences, which may apply to different contexts or devices. One user may have multiple preference sets, such as preferences for home, for school, for their desktop, or for their mobile device.

This project is focused on creating, refining and maintaining preference sets for users in order to support **access to information communication technology (ICT)**, including technologies, tools, devices and resources; **ease of use of ICT** by all users, including non-technical users; and **increased participation** by individuals in all of the activities that require ICT or that ICT can enable, including the activities that establish their needs and preferences.

The specific objectives of this project (Year One and beyond) are to:

1. Provide a knowledge base on proposed user preference gathering systems for people with disabilities, including expert judgment on how best to assist users in specifying the appropriate aspects of these preferences.
2. Develop a system of tools and technological architecture that supports creation of user preferences for people with disabilities, is operable as a Web application or system of applications that reflects expert judgment, and supports continuing evolution of the content of user preferences and of the means of assistance provided to users. These tools should:
 - Allow users to create initial preference sets and preference sets for different contexts;
 - Encourage users to manage their preference set(s) through direct manipulation/editing, and by responding to suggestions created by inference engines monitoring their use and contexts—the aim being to support users over time, as their needs and preferences change, and as they develop increased understanding of what they require and what works best for them through the use of the tools;
 - Engage users, reduce the time it takes them to acquire their preferences, and allow them to quickly make changes to those preferences throughout the lifecycle of interacting with ICT; and
 - Be appropriate to different user groups—from power users to those who have limited experience with technology; to users who may not know what they want and need; to users of different ages, in different environments, and who utilize different technologies.
3. Aggregate and refine knowledge regarding what works for specific needs and preferences from a variety of knowledge sources including professionals, user feedback, and usage metrics, so that this can be used to guide the user in selecting preferences
4. Encourage ongoing development of preference tools within the community at large

3 Challenges

In addition to the challenges in Section 1, there are a number of complicating factors that make the creation of preference tools particularly difficult to do well.

3.1 Diversity of the Users

In considering all of the different types and degrees of disability that an individual may have, it is apparent that complex patterns of user needs occur even within a single disability type. The needs of someone who is completely blind, for example, are different from someone who has low vision and can see but cannot read text. And the needs of the individual who cannot read text are different from an individual who requires screen magnification for readability. Furthermore, individuals can and often

do have one or more disability concurrently—including a combination of both physical and cognitive disabilities. At the same time, individuals vary in terms of their technological self-efficacy, and some may not use computers at all. Accessibility solutions must be flexible and responsive enough to balance the need to overcome serious barriers to entry with the need to showcase diverse preference possibilities to users who are interested in them. Ultimately, accessibility solutions must meet the unique needs of each user.

3.2 Cognitive Access

Cognitive needs potentially impact the widest number of users; however, accessibility standards and solutions have not done an adequate job of addressing this group of users (Hudson et al., 2004). This is due to several factors, including the complexity and wide variation in the realm of cognitive needs, that there is a lack of developer education on the needs of cognitively impaired users, and that there is a lack of a single vehicle for capturing cognitive needs. When solutions do exist, they are either specialized stand-alone solutions with limited scope or are limited to a single application or web browser. In some cases, a limited focus on necessary requirements to specific cognitive constraints ignore their incongruence—and in some cases incompatibility—with preference solutions for other disabilities.

There is also an inherent paradox: some of the solutions intended to support individuals with cognitive needs, such as the timing and modality of reminder messages, may be beyond the cognitive ability of the user to comprehend and accurately select these preferences. This raises the potential role of assistance or helpers in preference collection.

3.3 Personalization

Research has shown that when users are provided with the opportunity to change their preference settings, they rarely do so (Iyengar et al., 2000; Trewin, 2000; Forrester, 2004; Spool, 2011). Trewin (2000) discusses barriers to personalization of preferences for less experienced users in particular, including lack of awareness of available options, lack of knowledge of how to change settings, difficulty identifying the solution to meet a given preference or need, and a lack of control over the unconfigured interface. This presents a challenge, especially in light of the fact that assistive technology (AT) solutions do not provide “session support”—a way for users to easily explore and get assistance if needed when creating or changing settings. A recent study by the Pew Research Center found that 63 percent of non-Internet users would need assistance in getting started on the Internet (Zickurh, 2013). And an earlier study by Pew identified people with disabilities as 27 percentage points less likely to use the Internet than their non-disabled peers (Fox, 2011).

However, the fact that it is difficult for users to understand or configure technology to meet their needs should not be confused with the critical importance of being able to do so. Bridging this gap is one of the key goals of this project.

3.4 Solution Readiness and Awareness

Beyond the complicating factors listed above tied to user-centered design, this project seeks to address the complexities involved in creating scalable software architecture. The creation of globally accessible and highly personalizable solutions require that the software is designed to be easily understood, extended, and adapted for use across many platforms and contexts. One-size-fits-one solutions, which this project seeks to build upon and create, are in the early stages of readiness for mainstream consumption. We foresee that in some cases, challenges may arise due to unwillingness on the part of proprietary platform providers to adopt open source solutions, in other cases, developers may not have a clear understanding of the concepts or systems used to build and implement tools. We must also address interoperability and platform dependency challenges, find ways to support non-experts in understanding and integrating tools into their software systems in a scalable way, and recognize and attempt to address the cost and time intensive implementation processes.

4 PGA Results Year One

The PGA team delivered three critical outputs in the field of accessibility that will have a transformational impact on this project and the industry as a whole: 1) We deepened understanding of the diversity of user preferences, including cognitive access and advocacy momentum to guide new forms of support for users with cognitive impairments; 2) we created the Preference Tool Ecosystem, which is a set of concepts and paradigm-shifting maps for software development toolkits for preference acquisition; and 3) we designed specifications for the Preference Framework—an architectural framework capable of supporting exchange of preference tools and data across platforms and networks.

4.1 Preference Matrix and Cognitive Preferences

The Preferences Matrix, developed as part of our knowledge building work, contains an extended list of disabilities and to include cognitive needs, contextual needs, and individual learning styles with examples of their functional equivalents, or preferences that move beyond existing work in the accessibility and special education literature.

In compiling the preferences matrix our work revealed that although cognitive needs, in particular, potentially impact the widest number of users, accessibility standards and solutions have not done an adequate job of addressing this group of users. The PGA team produced a concise inventory of requirements needed to support users with cognitive impairments that revealed opportunity spaces for advancing the field such as awareness of the deep inadequacy of current digital math solutions capable of serving users with cognitive constraints, insights around the potential impact of widespread use of well-known technological supports like breadcrumbs on access for users with cognitive constraints, and guidance for where to get started in an area long-regarded as too difficult to design for.

4.2 Establishment of Guiding Concepts

In order to successfully build the tools to support preference gathering in line with the PGA project goals and challenges, it was critical to develop ways for understanding how users enter into and move around in preference environments, how to efficiently capture preferences, and which interaction methods and design strategies are most suitable to engage and support users. Thus, to lay the groundwork for the Preference Tool Ecosystem, the team created concepts and conceptualizations around user activity spaces, interaction methods, inference methods, and tool design.

Conceptualized User Activity Spaces. Considering the diversity of users, it became clear in our work that users would require different points of entry into preference collection activities. They would need to choose how, where, and when they engage with the tools, all in light of their context, diverse experiences, attitudes, and access to support. From this foundation of user and contextual diversity, the team identified the activities users would potentially require for meaningful engagement with preferences, and created names for various “activity spaces” users would inhabit.

The five activity spaces developed by the PGA team include:

1. **First Create** - This activity space is essential for users who are not already computer users. When in this activity space, the novice user is supported in determining what is needed in order to be able to use the computer (or other devices) at all. (If users can already use the computer, then they could use *Capture* to start with the settings they already use. From there, they could go into an *Explore* activity to find out what really works for them. If the user has no useful ability to operate the computer – then First Create would be used. After First Create, that user would likely then use Explore.)
2. **Capture** – If users are already using a computer, their current settings can be used as a starting point, understanding that default settings should not be presumed to serve the user well. Capture can also be used at any time to capture a particular set of settings – for example to capture a new set to be used for a particular context such as a set of preferences that work well for that user in libraries.
3. **Explore** - In the Explore activity space, users who have at least basic access, are encouraged to try new configurations, find new transformations, and discover new preferences without fear of permanently losing their current level of access.
4. **Adjust** - This activity involves providing the user with the ability to easily adjust a single preference, or adjust multiple preferences.
5. **Manage** - Manage covers a wide range of advanced activities involving the viewing, editing, and/or re-organizing of preference sets.

It is important to note that within this conceptualization, users will not necessarily move through the five activity spaces in a linear progression, but rather the activity spaces represent different ways that users may interact with preference tools in different contexts.

Identified Interaction Methods. Interaction methods are the techniques for presenting and providing preference features to users. The aim is to offer appropriate methods within each activity space to engage the user to discover, explore, and adjust preferences—toward the ultimate goal of increasing user engagement and success in completing the preference process. The following interaction methods were identified:

- **Prompt & Ask** - The most direct method is to explicitly prompt the user to make a selection for a preference.
- **Tasks & Rewards** - These may include game-like interactions that are highly engaging and stimulating, or more straightforward questions or a combination of both.
- **Show** - The user may wish to have the system show specific preferences or types of preferences that are available, as well as the specific adjustments that are available for each preference.
- **Randomize & Try** - When not much is known about the user, a preset or common selection of customizations (or selections predicted from other information gathered about the user) could be presented for the user to preview. They could try the customizations offered or ask for a new set of choices.
- **Infer & Recommend** - To reduce preference gathering time it is beneficial to infer and recommend preferences and let the user to decide whether to add them to their profile.

Identified Core Design Requirements. We identified nine concrete requirements for preference tools if they are to meet users where they are, rather than expecting them to adapt to yet another system with unfamiliar interactions. The preference tools should cumulatively:

1. Encourage exploration and experimentation
2. Demonstrate the chosen preference
3. Ensure that users are informed
4. Ensure that users are allowed to control preference selections.
5. Integrate preference management into user workflow
6. Enable continuous refinement
7. Integrate usable decision support wisdom, by providing feedback to the user on what preferences have worked in similar circumstances for others or by communication with other users
8. Provide a range of interfaces, ranging from ultra-simple to full-featured
9. Where possible, infer and suggest user needs by monitoring their interaction with the system to improve the user experience.

4.3 The Definition of a Preference Tool Ecosystem

The Preference Tool Ecosystem is composed of three general categories of tools: initialization tools, exploration tools, and editors. Within each of these categories, we

have identified specific tools aligned to each of the user activity spaces. The ones which we will cover in greater detail will be First Discovery and Exploration tools as these tools are the most critical in assisting the user in acquiring their needs and allowing them to get through the preference gathering process with the greatest speed and with ongoing refinement by engaging the user.

First Discovery Tools. The role of *First Discovery Tools* is to find out what the basic needs of a person are, needs that, if they are not met, would prevent the person from using the ICT at all. First Discovery and addressing access to single sign form the key components necessary to getting a user “in the door” to any ICT system and then on to any preference gathering tool to enhance their access. Until we know these basic needs we cannot begin to give the user an *Explore* tool because we do not know what would be within their ability to perceive or understand. Most users who use a First Discovery tool will then be guided toward a tool to Explore. First Discovery tools are only used with people who do not currently use ICT and therefore do not already have settings or AT that can be captured and used as a starting point.

A First Discovery tool is probably one of the most challenging tools since it must start without any assumptions about the user and slowly establish what types of input and output a user is able to interact with, before moving into a space of preference setting activity.

Within First Discovery, all of the underlying complexity of the preference exploration and preference management tools exists. However, additional complexities must also be accommodated. These include: determining what can be used for input or response from the user when the user cannot operate one or all of the traditional computer input devices (keyboard or mouse or touchscreen), and determining what can be used to present information to the user when the user cannot perceive or understand one or all of the traditional computer output (audio, video, braille display, etc.).

First Discovery must therefore employ a different strategy from the other preference gathering tools. With First Discovery we need to turn on many of the accessibility features, critical to getting the user in the door, such as text to speech and then begin to systematically remove settings. Other preference tools are more often than not additive, enhancing existing settings as the user goes through the preference gathering process.

We expect First Discovery to primarily rely on the following interaction methods:

- **Prompt & Ask:** First discovery tools are particularly challenging because they must have an interface that is operable by everyone no matter what their disability or combination of disabilities. This means that they must have parallel presentations (visual, auditory, tactile) and accept a wide variety of different response modes (voice, keyboard, touchscreen, pointing device, alternate input devices), especially in the initial moments. The system may need to try several different types of prompts or questions. For example, this might mean presenting an initial prompt in textual, audio, and visual formats (icon and sign).
- **Infer & Recommend:** Based on user input in response to prompts, questions, tasks and games, we expect the systems will need to infer which presentation modes are

perceivable and understandable and usable for the user, but constantly check and confirm any inferences. Inference can be very important in helping to guide the discovery tool in efficiently trying different strategies in the early stages where effective communication with the user has not yet been established. The tool then needs to adapt all of its inputs and outputs to those modes

The key goal of this First Discovery process is to determine the limits beyond which the individual cannot perform (e.g., font sizes that will be too small for them to read, keys that are too small for them to hit, and controls that they cannot operate), and a rough estimate of their preferences along these basic parameters (e.g. approximate font size they like).

From here the user would likely proceed into an exploration tool to refine their preferences. They may do this directly or after they have had a chance to use their new access for a while.

Capture and Create Tool. As discussed previously, users who are already using access technologies (AT or built-in access features) can more easily create a first Needs & Preferences set by simply using a Capture and Create tool that would capture their current settings and preferences and create their first Needs & Preferences set from that versus going through the Discovery process. From there they can move on to the *Explore* tools to find out if there are better settings for them.

Exploration Tools. Exploration Tools provide a means for users to explore ways to personalize their experience in the context of a task they are performing. They are intended to expand the user's understanding of the possibilities of personalized interfaces. Different exploration tools can support exploration and experimentation for different groups (by age, interest, ability, subject matter, task). We anticipate that the ecosystem will provide these contextualized tools, and that the role of the PGA project is to facilitate that by developing toolkits and providing exemplars.

Exploration Tools allow users to explore and play with content transformations and adaptations in context. Exploration tools may provide their own context, or they may allow the user to choose their own context (web page or task) and explore the effect of the different settings on that context. To operate in this latter form, a tool would need to be built so that it can be integrated into either web based or native applications.

As a part of our work in this area – a prototype Exploration Tool was developed. This tool provides users with presets, which are logically grouped selections of preferences with default settings.

Preferences Management Tools (PMTs) and Mini-PMTs. Preferences Management Tools (PMTs) are web-based tools that give users the ability to see and edit their preferences for any device, application, or context. As a concept, these tools are web based to provide cross-platform compatibility, ease of adaptability, and re-use of code. These are robust tools that provide the user with the ability to customize

preferences for one or many devices. They allow the user to change and apply global preferences or define and edit preferences for different specific devices and contexts.

Personal Control Panels (PCPs). Personal Control Panels (PCPs) provide users with an easy means to directly adjust the device's/software's settings on the fly. A PCP allows the user to quickly choose "for the moment" settings they may need from a short list of features they feel the need to have quick and constant access to. (This list of settings can be chosen by the user from her preference set, or pre-populated with settings the user might find useful). PCPs can also give users the option of saving settings for later use on that device or on other devices. That is, they can have preference saving capability – or they can launch a preference tool to do this.

- PCPs for a single person can be different in different contexts
- PCPs can launch Preference Tools
- A PCP could also have an embedded PMT

4.4 The Preferences Framework: Architecture Design

The Preferences framework architecture, designed to support PGA will be based on the following principles:

- *Reusable Components* Including: flexible UI components designed for adaptation to support preference creation and management; Pluggable personalization service to support transformation and delivery; web and native platform services building off Clour4All and Flexible Learning Object Environments (FLOE) work; robust scalable frameworks
- *Adaptable UIs vs transcoding* capable of supporting features such as highcontrast, text-to-speech, and layout simplification
- *Web and Native platform accessibility features*
- *Support for security and privacy*
- *Open Source code and documentation*

The preference framework architecture is illustrated in Figure 1.0. Figure 1, below, illustrates the components that are offered within the Preferences Framework, as well as some of the services and tools they interact within in the broader GPII ecosystem. The Preferences Framework offers: 1) Views and Adjusters, which provide reusable widgets and controls with which users can edit their preferences; 2) Enactors, which do the work of transforming the user interfaces based on these preferences; 3) Data Stores, which provide persistence for the user's preferences; and 4) Recognizers, which provide activities to help infer new preferences and settings. These components typically interact with both web content and a suite of native/server-side GPII transformation services, including the Flow Manager, which is responsible for configuring and launching native access solutions.

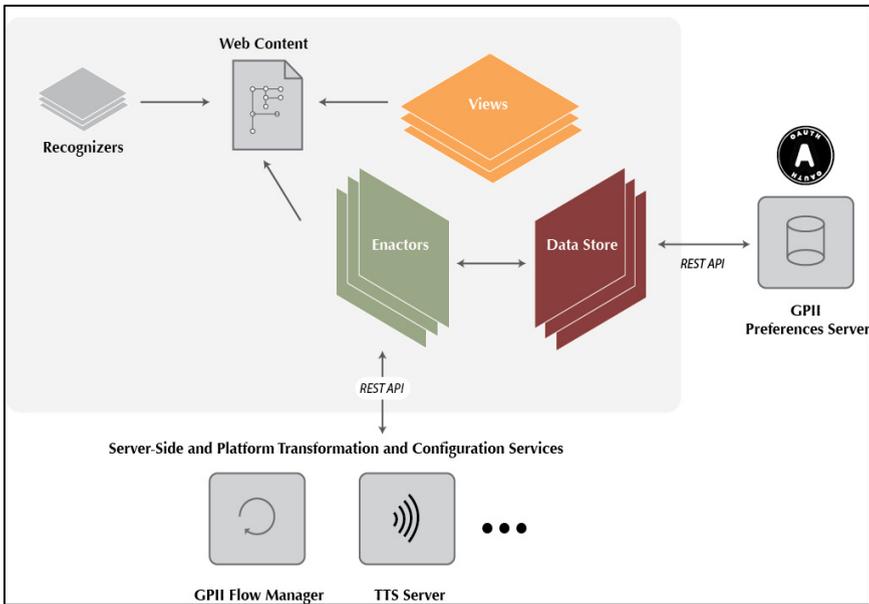


Fig. 1. The Components of the Preferences Framework

5 Conclusion

A Preference Tool Ecosystem and Preferences Framework has been created that takes a functional approach to determining personal preference sets, acknowledges the importance of self-awareness and self-determination while also facilitating guidance from a variety of knowledge sources. These models acknowledge that there can be no one authority or initiative that can support this hugely complex domain and that any system or infrastructure must support collaborative, collective, distributed input and development in order to be sustainable and scalable.

The next stage of the project requires the engagement of the broad spectrum of users, potential developers, knowledge sources and implementers in the participatory design and development process. In collaboration with other GPII efforts, the PGA initiative will create the necessary architecture to support the creation of the ecosystem of preference tools delineated in the first phase of the project and PGA will also create exemplars and models of the range of tools that can be implemented and tested with a special emphasis on first creation and inference.

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