Using Standards to Get Closer to Delivering the 5 R's*

Fraunhofer Institut
Angewandte
Informationstechnik

* The Right Information at the Right Time, in the Right Place, in the Right Way to the Right Person

Using standards to get closer to delivering the 5 R's

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L^{3}D

Boulder Colorado

Overview of talk

- Me
- The 5 Rs
- Universe of one
  - Distributed cognition
  - Metadesign
- EU4ALL
- Further research

Stefan Carmien

- MS, MS PhD form CU
- MS & PHD in L^{3}D
  - Dissertation & MAPS
  - Clever
- Post doc at Fraunhofer
  - EC projects
  - EU4ALL
- On to Spain…

The 5 Rs and L³D

The Right Information at the Right Time, in the Right Place, in the Right Way to the Right Person

- right information: relevant to the task at hand → task modelling
- right time: intrusiveness (pull versus push)
- right place: location-aware cell phone (noisy environment versus movie theatre), smart tour guides
- right way: multimodal presentation (textual, visual, auditory, tactile)
- right person: taking background knowledge and interests of specific users into account → user modelling, “who do I ask and who do I tell”

Who owns this phrase?

The 5 Rs and L³D

Who owns this phrase?

Google thinks we do....

This part of the presentation gives us the oportunity to generate together some ideas about what these phrases mean and produce some examples

Right Information

- Critiquing systems
- Admin versus user mode
- Dynamically depending on context

Right Time

- Critiquing system
- Error trapping - breakdowns as triggers
- Context - dependent on current context and path thru context
- When is it the wrong time? (only flag errors)

Right Place

- We could discuss what this means
  - i.e. is this in the list for completeness or is it meaningful?
- What possible places are there?
  - Emergency medical information vs bedside?
  - MAPS vs. Visions

Right Way

- Personalization
  - MAPS
  - OS preferences
  - EU4ALL
  - Depth issues

Right Person

– Again, think of an example where this is interesting
– Administrator versus user?
– Parental controls?

VLE's and Contnet Personalizaion

- The right way & right place (?)
- Systemic apprch based on
  - WCAG
  - IMS
  - ISO
- Automatic system wide adataiton

Overview of universe of one

– Disabilities are often complex mixtures
  - Reduced intellectual ability combined with
    - Sensory impairments
    - Motoric impairments
    - Psychological / developmental impairments

– Funcitonal personaliziaon
  - In contrast to diagnosis
  - Allows for temorary disablity (I.e. driving car)

End-users comprise a set of one

Universe of one and Universe of all

- The universe of one dilemma is one end of an axis
- The other end is truly “one size fits all”
- All interface design problems fall on this axis
- Applicability
  - Is design for all just good design in the first place?
  - Curb cut / space effect transferability

Distributed Cognition

- Knowledge about world contained in external artefacts, internal mental structures, and social roles
- The cognitive act is distributed across them
- Examples:
  - Memorization ➔ books & reading
  - Flying a modern plane ➔ pilot & instruments
  - Ikea or Lego assembly instructions
- Using a distributed cognition design approach often changes the users task

Two approaches to deep customization

- End user programming
  - Support the end user becoming a co-designer of the system

- User (and Device and Content) modelling
  - Model the user and other components and base delivery on the models
  - Make user model dynamic and scrutible

EU4ALL

A European Unified Approach for Assisted Lifelong Learning

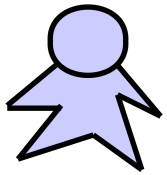
A EC project 2006-2009

EU4ALL

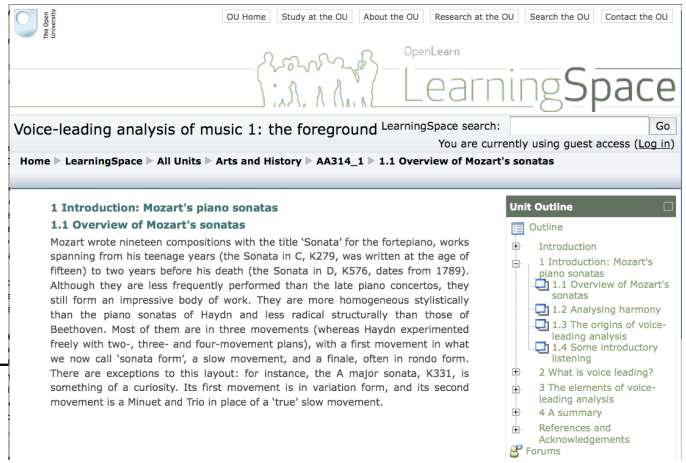
- Content personalization
- Repositories of pedagogial content
- Content replacement not adaptation approach
- User requests a unit of educational content as part of a class
- EU4ALL provides the user personalized content

Deep personalization is dependent on three things:

- **The user**
  - Specific abilities
  - Specific needs (I.e. sensory..)
  - Preferences in adaptation



- **The context**
  - The user agent
  - The environment (network accessibility, temperature, light)
  - Local availability of resources (I.e. printers, Java, browser)
- **The content material or task**
  - Accessibility qualities
  - Display specifics I.e. mime type
  - Network requirements



Contnet personaliziaon formula

UM + DM + DRD = CP

UM and DM and DRD must have matching attributes and range of values

Tightly controlled vocabularies

Domain dependant

Scenario based design of standards

Distance learning and standards

- LOM
- Dublin Core
- IMS
  - ACCLip
  - ACCm-the document one
- ISO
  - DRD, PNP

The User and the Environment

- All of these assume that the information about the users device belongs with the user model
- User agent & environment & hardware = DM
  - Environment boundries - start with network attributes
  - Balhblah balh

EU4ALL

- The designers of the EU4ALL system can't predict what every use might need
- Using user and device modelling and matching it with content modelling
- Dynamically providing the right content

User Modelling: PNP
Device modelling: CC/PP
Content Metadata: DRD
Content Personalization: CP
PNP + CC/PP + DRD = CP

Eu4all overview

- By making the delivery context independent to user model we provide deep customization
- This solution assumes we know enough about
  - User agent (mime types & assistive technology)
  - User model (domain experts lists of functional needs)
  - Content - availability and display requirements (I.e. network bandwidth greater than XX and java)

Example

Four scenarios:

#	Missing ability	Example	Example	Orig. access mode (s)	Adaptation type	Content media requirements
1a	Auditory	Tape of talk	Tape of talk	Audio	Transcription	Mime text type
1b	Visual	Text of lesson	Text of lesson	Text	Audio tape	Mp3 mime type Streaming
2	Visual	Physics lecture on video tape	Physics lecture on video tape	Visual and Auditory Two entries in metadata pointing at the same original content object: Visual and Auditory - See below		
2 visual	Visual		Demonstration part of above	Visual part	Audio Description	Mp3 mime type Streaming
2 auditory	Visual		Lecture part of video	Auditory part	<none> NOTE: this is an *.avi	AVI Mime type Streaming
3	Visual	Text as part of a photo	Text as part of a photo	Visual	OCR?	Mp3
4	Visual	Text (a book etc.)	Text (a book etc.)	Visual	Text to audio DM transformation	Mp3

ISO 24751-1 - PNP

Attribute	Allowed Occurrences	Datatype
adaptation preference	Zero or more per *Content*	Adaptation_Preference

Attribute	Allowed Occurrences	Datatype
sage	*Zero or one per Adaptation Preference*	usage_vocabulary Pg 80
daptation type	Zero or one per *Adaptation Preference*	adaptation_type_vocabulary Pg 64
riginal access mode	One per *Adaptation Preference*	access_mode_vocabulary pg 63
daptaion_preference ranking = not DM or RD	Zero or more per *Adaptation Preference*	Integer – the preference rank of the possible adaptation (i.e. 2 adaptation types for the same original access mode could exist)

Vocab

- **The 5 basic "access mode" values are:**
- visual
- textual
- auditory
- tactile

–olfactory

–The 9 basic "adaptation type" values are:

–audio representation
–visual representation
–text representation
–tactile representation
–caption
–audio description
–Braille
–digital talking book
–electronic book

UAProf

Attribute	Description	Resolution	Type	Sample Values
Mime_Type	List of the IANA mime type(s) that can be 'played' on this device	Append?	Literal (bag)	"Audio.MP3" See IANA mime type listings for vocabulary
AT-Transformation type	a bag of literal each literal represents a given transformation (scenarios)	??	Literal (bag)	Could be integers could be 'audio-to-text'

- Put some mime types here
- List some AT-transformaitons here

DRD

Attribute	Allowed Occurrences	Datatype
Media_Object _ID	One time per Access For All Resource	*EU4ALL Identifier*
ccess mode statement	Zero or more per Access For All Resource	Access_Mode_Statement –
as adaptation	Zero or more per Access For All Resource	*EU4ALL Identifier*
s adaptation	Zero or one per Access For All Resource	Is_Adaptation –
daptation statement	Zero or more per Access For All Resource	*Adaptation_Statement*
Mime_type –	*Zero or more per Access Mode Statement*	*Mime type vocabulary from iana site –*

Access mode

Attribute	Allowed Occurrences	Datatype
riginal access mode	One per Access Mode Statement	access_mode_vocabulary
ccess mode usage	Zero or one per Access Mode Statement	access_mode_usage_vocabulary -

Is adaptation

Attribute	Allowed Occurrences	Datatype
s adaptation of	One per Is Adaptation	*EU4ALL Identifier*
xtent	One per Is Adaptation –	extent_vocabulary

Adaptation statment

Attribute	Allowed Occurrences	Datatype
daptation type	Zero or one per Adaptation Statement	*adaptation_type_vocabulary*
riginal access mode	One per Adaptation Statement	*access_mode_vocabulary*
xtent	Zero or one per Adaptation Statement	*extent_vocabulary*
Mime_type	Zero or more per Adaptation Statement	*Mime type vocabulary from iana site –*

Vocabulary

– PNP
– MIME type

Why do this so crudely? Is this not the age of the Semantic Web?

– Good question

- This would involve a lot of AI & inference making
- More stuff…

The standardization process

- Need for agreed upon standard vocabulary
- Changes are difficult
- On-demand adaptation is much bigger problem
- Part of design for all approach

What EU4ALL misses

- Who does all the content and who keeps it up to date?
- Sensory adaptations much easier than intellectual disability adaptations
  - Similar to the problem of adapting web content
  - Is this even a real (I.e. logically solvable) problem?

Further research topics

- Prompting
  - True context awareness
  - Parameterized scripts
  - Automatic scaffolding retractions / extension
- eLearning content personalization
  - Automatic adaptation (I.e. modifying existing content on the fly)
  - Standards - granularity & assistive technology
  - Authoring issues (who will bell the cat?)

Questions?

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Distributed cognition

Using a distributed cognition design approach often changes the users task

- This can lead to de-skilling
- Deciding to use distributed cognition approach depends on
  - Cost to access
  - Importance of reliability
  - Frequency of use

"I won the spell-check bee."

More L³D Research threads

- Design with scenarios and user participatory design
- Socio-technical environments and wicked problems
- Power of representations
- Cross discipline research groups (symmetry of ignorance)
- Scaffolding
- Errors and plans
- Personalization
- Web 2.0 and semantic web technologies

Design with scenarios and user participatory design

- Provide an appropriate venue for the end user to participate in the design process
- To ensure the validity of the final design and implementation.
- Working with persons with cognitive disabilities, the nature of the end-user prohibited any end-user input of consequence
  - end-user proxies (caregivers and professionals in special education)
  - Scenarios
- Scenarios can be used in a structured way for initial design
  - with claims assertion to ensure that the design is valid
- Scenario based design can support shareholder analysis and participation by revealing implicit parameters in the prototypes design supporting discussion before coding is done.

The Power of Representations

Solving a problem may simply mean representing it so as to make the solution transparent

Here is an example: two person game

Take the numbers from 1 to 9

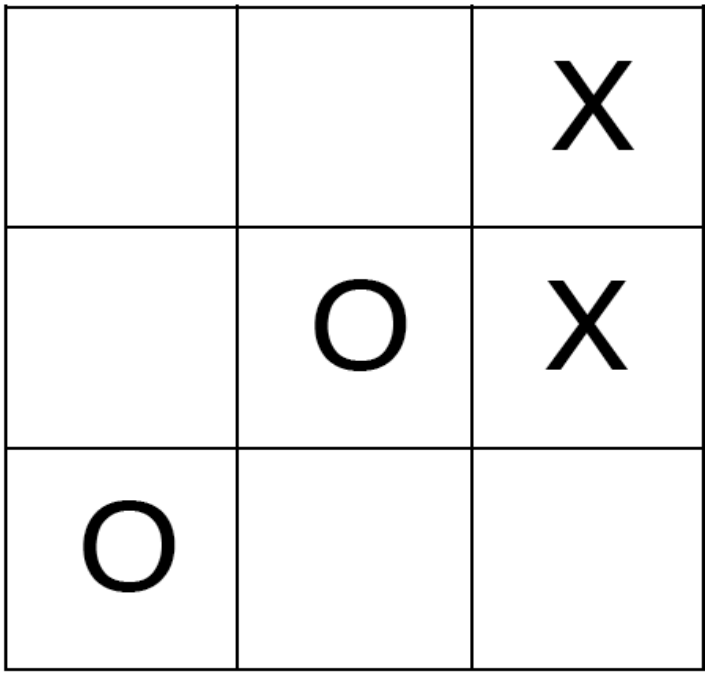
Players alternate and take one of the numbers

The player who can add exactly three numbers in her/his possession to equal 15 will win

1,2,3,4,5,6,7,8,9

The Power of Representations

Tic-Tac-Toe



Grade school children can beat graduate students

Socio-technical Environments and Wicked Problems

- Computer systems that are designed for interaction with people (in contrast to, say, rocket guidance software) are properly studied in place.
- The system, it's context and the human users form a socio-technical environment
  - The system itself
  - The members (actors/stakeholders) of a system
  - The interactions and the changes in work practices that the introduction of the computational artefacts induce.
- Socio-technical environments are often *Wicked Problems*
  - Human systems with multiple stake holders (some of which are very implicit, e.g. the legal system)
  - Interjection of computational artefacts changes the environments work practices

Wicked Problems….

- In terms of design, wicked problems in socio-technical environments often require iterations of design, implementation, evaluation cycles to satisfice the stakeholders.
- Typically, solutions to wicked problems are not optimal but satisficing, that is acceptable to all stakeholders.
- A corollary to this in the domain of task support for persons with cognitive disabilities:
  - One critical part of the solution is when and how to bring human intervention.
  - Because the range of error states is too vast to be solved without the possibility of human intervention.

Cross Discipline Research Groups (Symmetry of Ignorance)

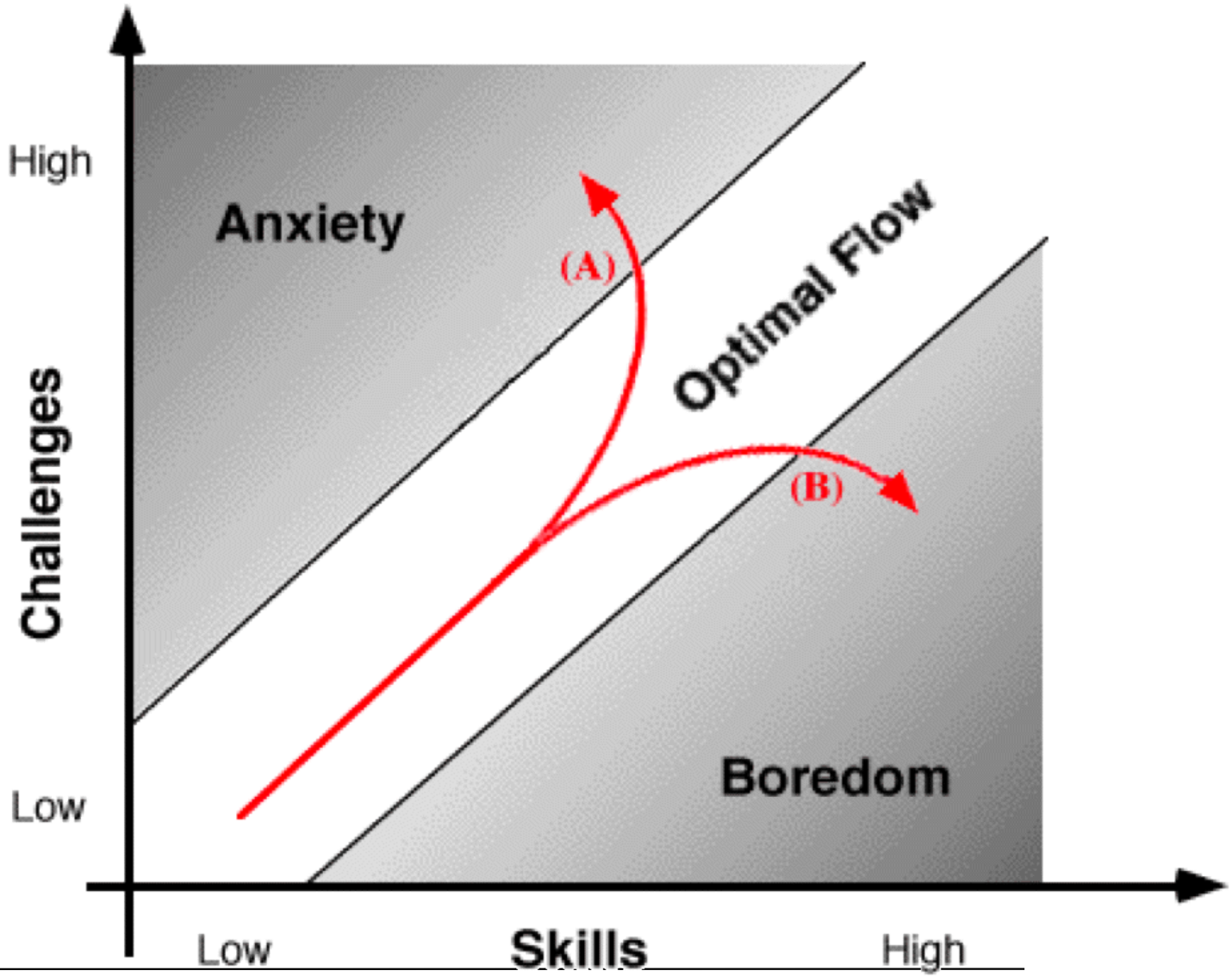
- It was possible in the Renaissance for a single man to gain knowledge and skills that might span human knowledge, but the explosion of knowledge and human endeavour precludes now
- How can we expect an individual to maintain the requisite specialist knowledge in their technological discipline, while at the same time have the needed competence in industrial design, sociology, anthropology, psychology, etc.?
- The solution to this dilemma lies in the notion of Renaissance team:
  - a social network of specialists from different disciplines working as a team with a common language.
- One way of seeing this is the exploitation of the symmetry of ignorance
  - By exploiting my expertise in an area you are lacking in (and vice versa, over a group)
  - This requires support by CSCW tools and structured participation o be more than trivial
- In a balanced team the deficiency of knowledge in one member will be balanced by the expertise being held by another member, and this symmetry is spread across the research team

Scaffolding

- Supporting human goals with computational artefacts must take into account the variability of human need and have a goal of fitting them, one measure of which is the concept of flow.
- One way of providing an optimised set of tools is to provide scaffolding
  - The interface changing as the user model changes
  - Reflecting the users current skill set and needs - learning Java example
- Examples:
  - Teaching Java programming, learning the scientific method, guiding collaborative learning
  - Menu items in Microsoft office the items displayed in a given menu reflects the most recent set of items selected.
  - This example is a particularly apt example of scaffolding changing inappropriately, as for many users it is disorienting and causes more problems than a non-changing menu set did.
- In MAPS, as parts of a script become memorized and become part of an internal repertory of sub-scripts, they were replaced in a following script with a single cue for that internal memorized set of instructions.
- Just as internalisation of a sub-task can trigger scaffold retraction, so, for an aging population, with progressively decreasing cognitive abilities, scaffolding must automatically extend to provide well-fitted support.

Scaffolding

- Scaffolding reflects flow optimization
  - As skills change
  - As challenges & tasks change
- Mihaly Csikszentmihalyi



Errors and plans

- Developing and understanding tools for task support
- Tasks can be analyzed in terms of:
  - Goals
  - Plans
  - Actions
- As an example, the solution of a constrained problem, supporting the washing of hands in a instrumented bathroom by Alzheimer patients with error correction and plan identification, took 5 years and many researchers from different disciplines

Errors and plans

There are two interesting problems associated with task support.

- The first one is to infer a plan and its goal (or a goal and its plan) on the basis of perceived actions of the end user.
  - This problem is a classic AI issue and has been extraordinarily difficult to solve in a general sense.
  - Handwashing example - solve intractable problem by constraining the solution space (I.e. instrumented bathroom, simple task)
  - Another strategy:
    - » First detect that a given state in any task as an error state
    - » Identifying whether one of the most common errors have been committed (with careful attention to the consequences using a confusion matrix analysis).
  - I have relied on domain expertise and the work of Norman , Lewis and Reason in creating a framework to understand and posit potential error states.
- If an error has been detected what to do?
  - Confusion matrix challenges - low hanging fruit
  - If not safely identified sometimes the best strategy is to bring human help into the situation.
  - This approach has been explored in MAPS prototypes in the lab, and will form part of my projected research agenda. In itself the appropriate summoning of human intervention is an interesting and relevant research target.

Personalization

- MAPS:
  - Persons with cognitive disabilities cannot not typically use abstract representations in prompting scripts and therefore need concrete image of the task to be done. This has lead to design (i.e. icons) the MAPS-DE which is designed to put pictures into scripts.
  - This is also an aspect of end-user programming and part of the motif of metadesign.
- Personalization leads to user models
  - Creation of consistent and high-fidelity model of the users needs and abilities
  - How to allow content reuse while creating support tools that are uniquely fitted to the user and task at hand?
- The personalisation research problem can also be seen as a facet of context aware computing, a system that requires knowledge of the environment and the task and the user to configure itself for providing a satisficing computationally enhanced environment .
- Research on developing standards to encode relevant information about the users needs and preferences, the software agent the user is interfacing with, and the access qualities desired task information or content

Web 2.0 and semantic web technologies

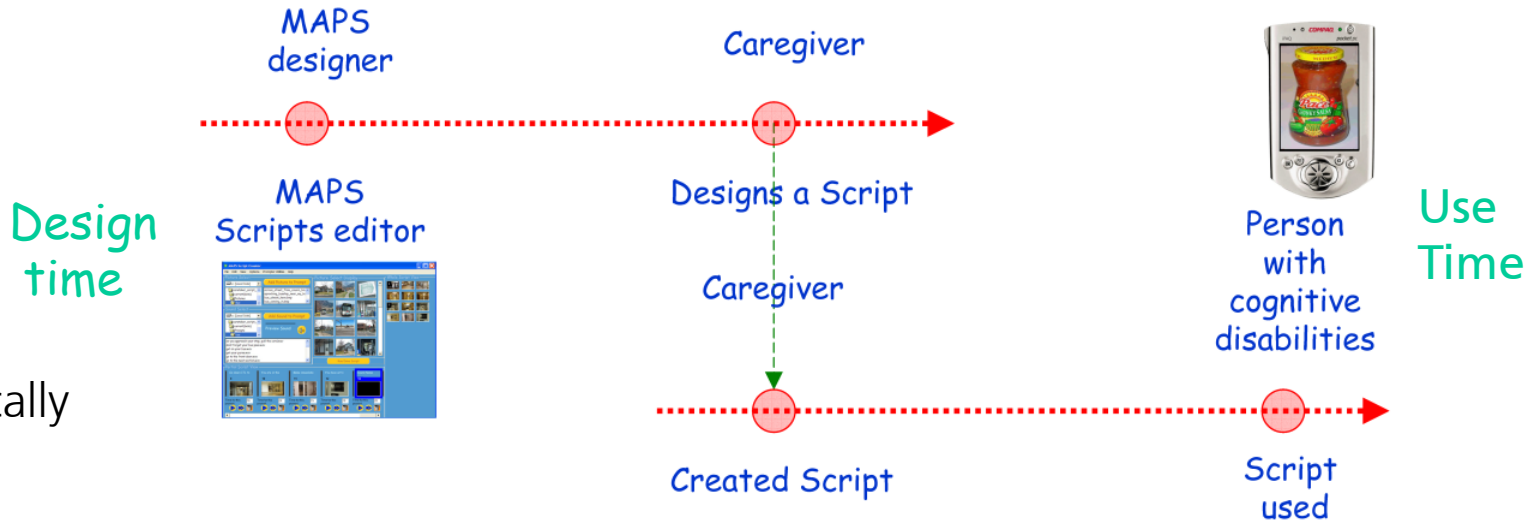
- The technologies of the semantic web and web 2.0 hold much promise in applying the same leverage of power by changing representation that is so very effective in supporting the human solution of problems (i.e. number scrabble which is an isomorph of tic-tack-toe,).
- By encoding the semantics of a piece of represented knowledge, typically currently a web page, into the representation, another dimension of leverage for supporting human tasks is possible.
- Combining this implicit enfolding of structure with new forms of representations of knowledge hierarchies and relationships, an example being the development and use of ontologies --> new possibilities for adaptation and regulation of computational support for human endeavours.
- Using metadata tagging technology with the semantic web's knowledge representation ability and context awareness creates a technical matrix where it is possible to move the promise of delivering the right knowledge in the right form at the right time from abstract goal to reality.

Metadesign

- There is not enough knowledge of *use time* specifics at *design time*
- Tool designers can't know all the tacit knowledge about a domain that has to be embedded in the application
- We can address this by underbuilding
- Metadesign is a approach to doing this

Metadesign

- Design for designers / Design over time
  - Design approach to making artifacts that can be used to design further artifacts
- End-users use metadesign tool to do design thus changing the tool
  - Design at tool design time
  - Design at metadesign tool use time



Metadesign tools are typically under-designed

Metadesign examples

- High level scripting languages
- Blogs / Wikis / Social Networking Apps.
- Web based Collaborative tools
- Buildings
- More examples…..

Theoretic underpinnings

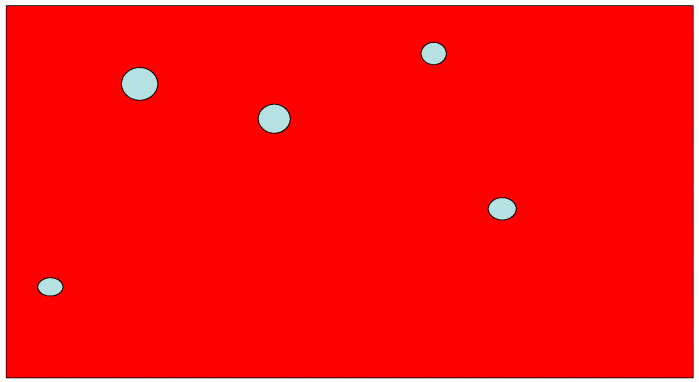
– By combining the perspectives of
  - Distributed cognition
  - Metadesign

– We have a framework to design computational supports for persons with cognitive disabilities in many domains

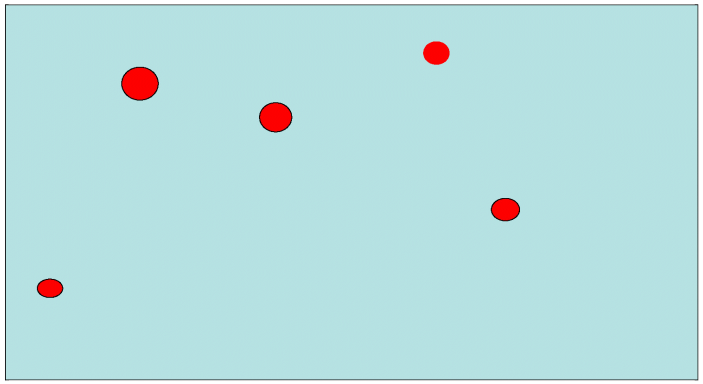
Universe of One

- This population often has variation in ability
  - Over time
    - Gradual decrease of ability in geriatric population
    - Gradual increase of ability in developmental population
    - Daily variation (bad day, bad time of this day)
    - Weekly variation
  - Over tasks

Islands of abilities in seas of deficits:
Unexpected abilities that can be leveraged

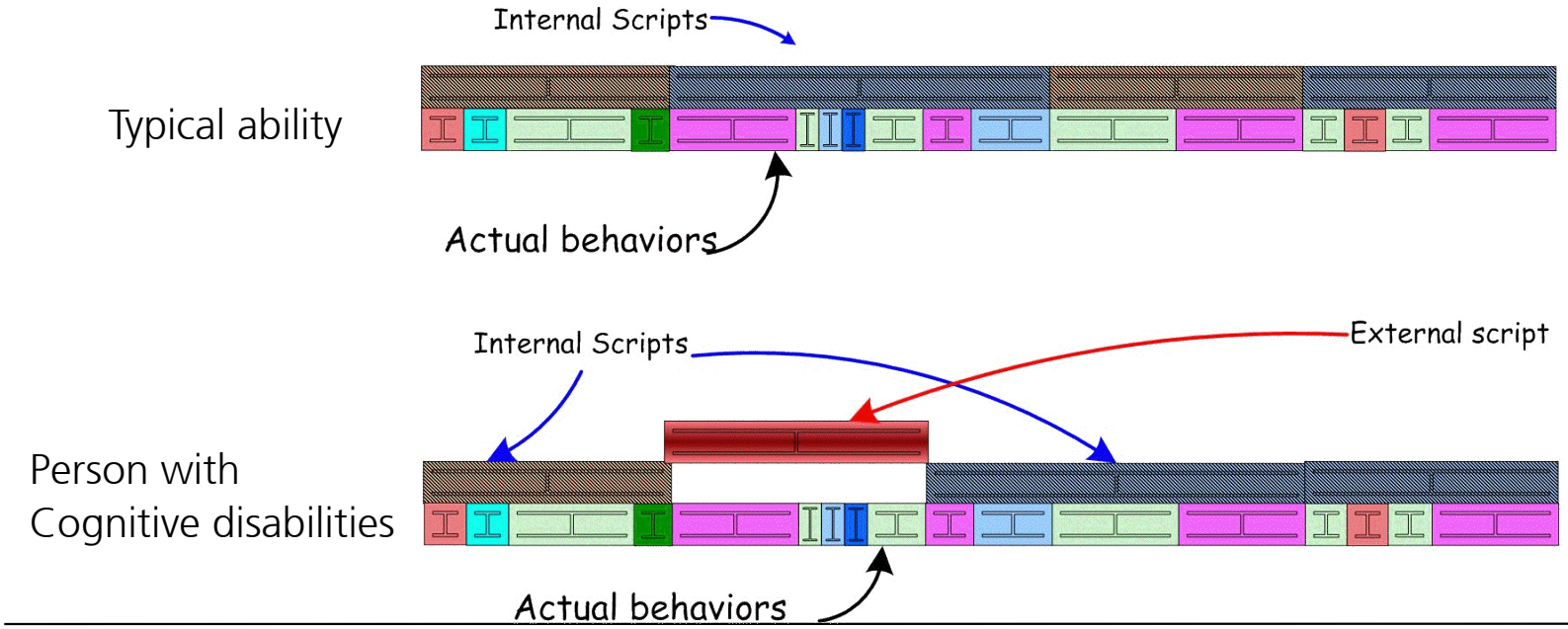


Islands of deficits in seas of abilities:
causes of unexpected activity failures



Distributed Cognition and Plans/Tasks

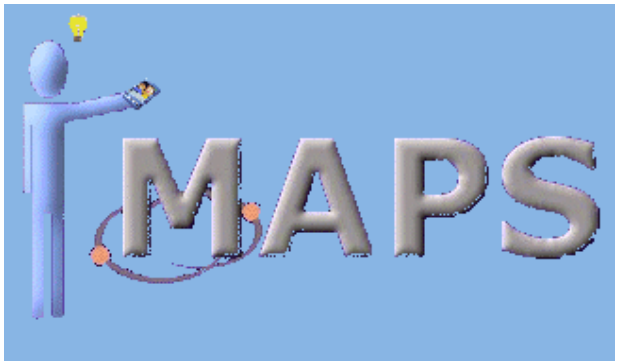
– Internal & external scripts
  - External Scripts - external artifact cueing internals scripts
  - Internal scripts - internalized sequences of behavior
  - Interplay between internal & external



MAPS

– **M**emory **A**iding **P**rompting **S**ystem

– End-users:



- Young Adults with Cognitive Disabilities
- Caregivers working with them

– An aid to performing Activities of Daily Living tasks

MAPS

– Prompting as task support
  - Scripts of prompts (prompt = image & voice)
  - Internal scripts / traditional use
  - External scripts & hand held computers

Environment Home
Activity Making a Sandwich
Student _____ **Please note kind of sandwich**

1-Independent
2-Model
3-Indirect Verbal
4-Gestural

	A	B	C	D	E	F
1		Modifications				
2	Gets bread package					
3	Opens bread package					
4	Takes out two slices					
5	Closes bread package					
6	Opens jar					
7	Gets knife					

–Computationally based prompting
  - Importance of specifics (image, voice)

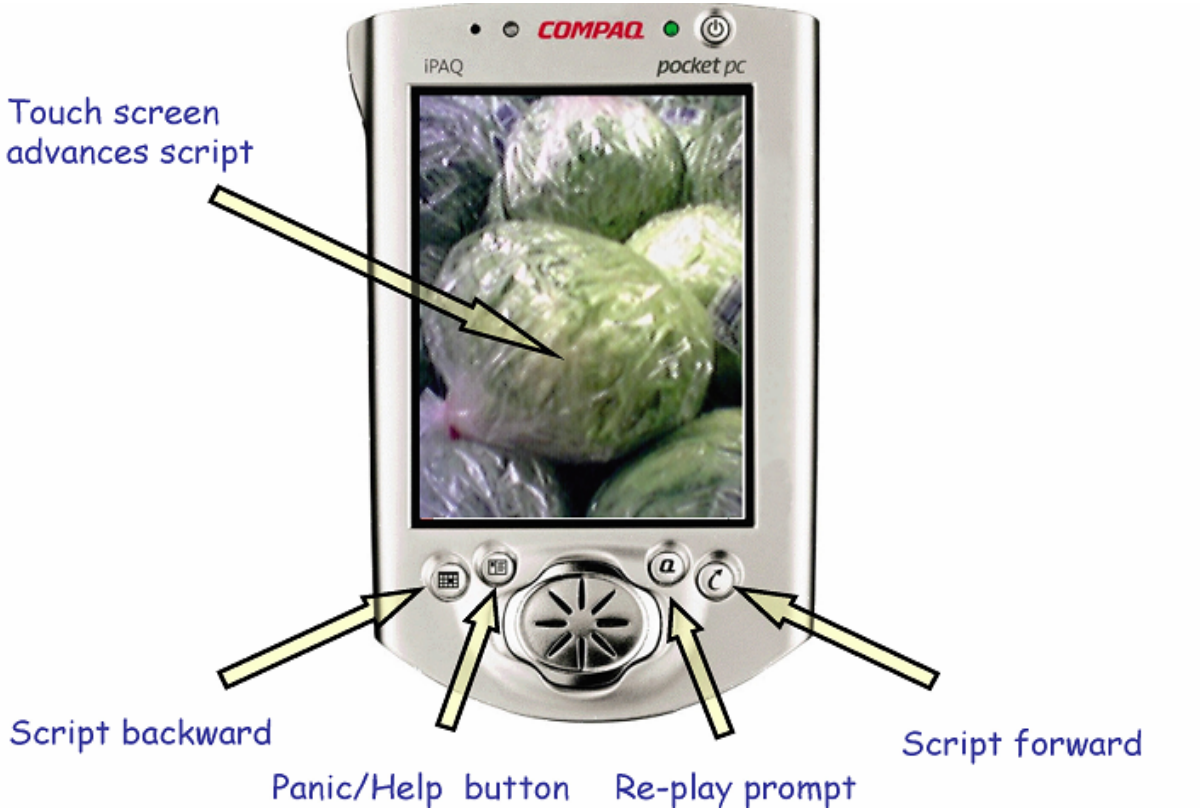
–End user programming problem

Editor

- Caregiver as programmer
- Usability
- Putting the right amount of domain in it
- Changeable scaffolding

Prompter

- Toasterize PDA
- 5 controls
- Stored on sd memory
- Mp3 player



MAPS users

- Persons with cognitive disabilities
- Caregivers
- Dyad - same data different interfaces
- Task changes
  - From: memorization of steps and sequence
  - To: using a prompter

Evaluation

User trials

1. **Controlled environment** script (e.g., a housekeeping chore), in which neither the task nor the environment is dynamic and the environment is familiar;

2. **Less controlled** script (e.g., cooking), in which the task doesn't change and the environment is dynamic but familiar;

3. **Least controlled** script (e.g., shopping), in which the task and the environment are unfamiliar and the environment changes

Leslie and Her Mom - High school

Leslie 16yrs, 3rd grade level

- Stay-at-home mom made scripts
- Tasks-
    1. Sweep kitchen
    2. Cook dinner
    3. Shop by self

MAPS and the 5R's

– Personalization with only standards at file level
– But the shared starter script