Content Personalization and Flexible Scaffolding in Support of Independence for Persons with Cognitive Disabilities

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Distributed Cognition and Metadata in System Design

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Slide 1

Content Personalization and Flexible Scaffolding in Support of Independence for Persons with Cognitive Disabilities

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Universität Siegen

Overview of talk

- Universe of one
  - Distributed cognition
  - Metadesign
- MAPS
- EU4ALL
- Further research

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Stefan Carmien

- BS, MS, PhD at University of Colorado

- Studied with Gerhard Fischer

- Worked in Center for LifeLong Living and Design (L^{3}D)

- Dissertation work was part of CLever project

- Currently staff at Fraunhofer Institute

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A Note About This Talk

– You have a lot of experience in

- End User Development

- New Media

- Community systems

- Cooperative support

– Please interrupt me with observations, criticism and questions

– I am not the 'sage on the stage'

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Overview of universe of one

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

– Because of lack of ability to abstract representations have to be specific and concrete
  - Pictures not icons
  - Specific human not synthetic voice

End-users comprise a set of one

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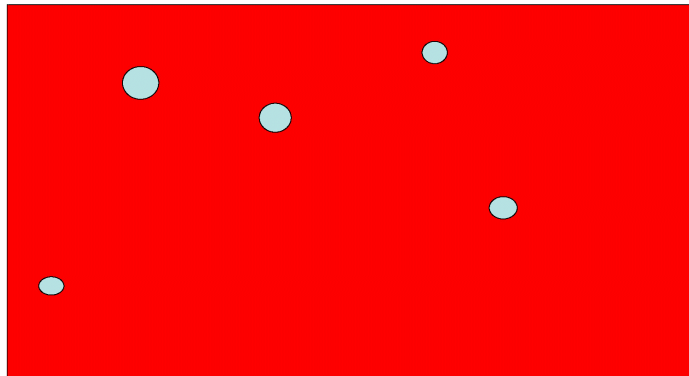
Islands of deficits in seas of abilities:
causes of unexpected activity failures

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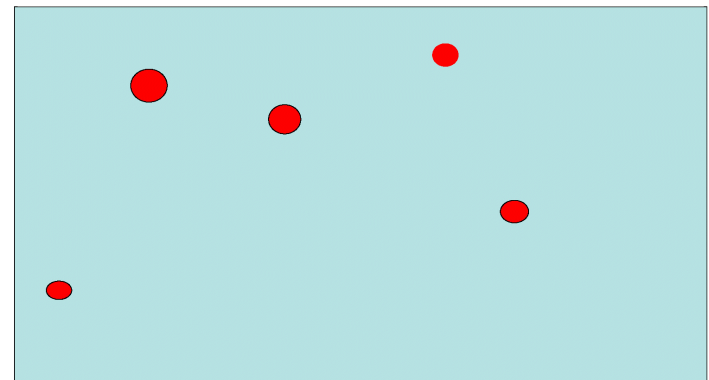
Universe of one and Universe of all

– 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

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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

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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

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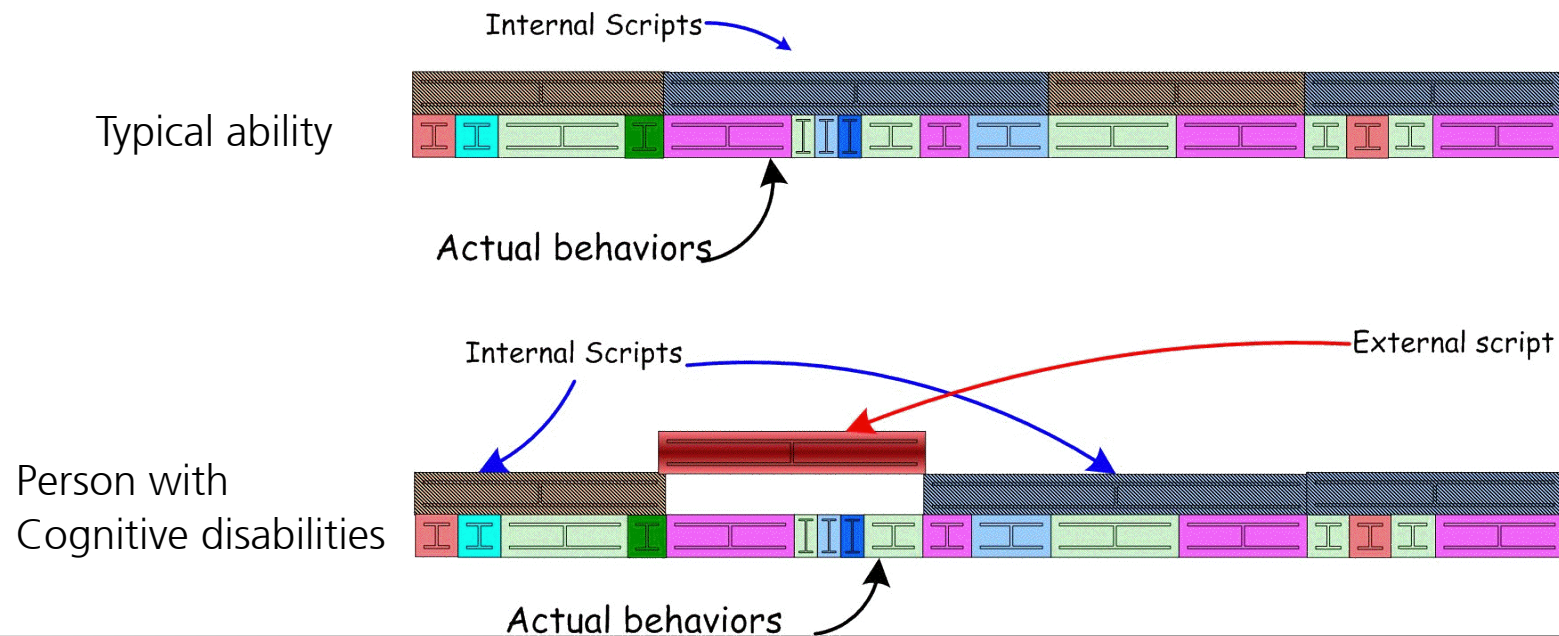
Distributed cognition

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."

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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

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Metadesign & Situated Action

- Situated use of computationally supported artefacts

  - Use at runtime always diverges from the envisioned use at design time

  - Lucy Suchman's work on situated action.

- Meta-design considers the design of tools that are to be evolving cognitive artefacts supporting human endeavours while evolving themselves as users needs and context changes.

- Much of this research involves thinking about (in the form of scenarios), and experimenting with systems to determine where the most leverage can be extracted for the user.

- Often the tradeoffs are spanning the continuum:

  - Generalized tool (e.g. compilers)

  - Toasterized devices (e.g. fax machine)

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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

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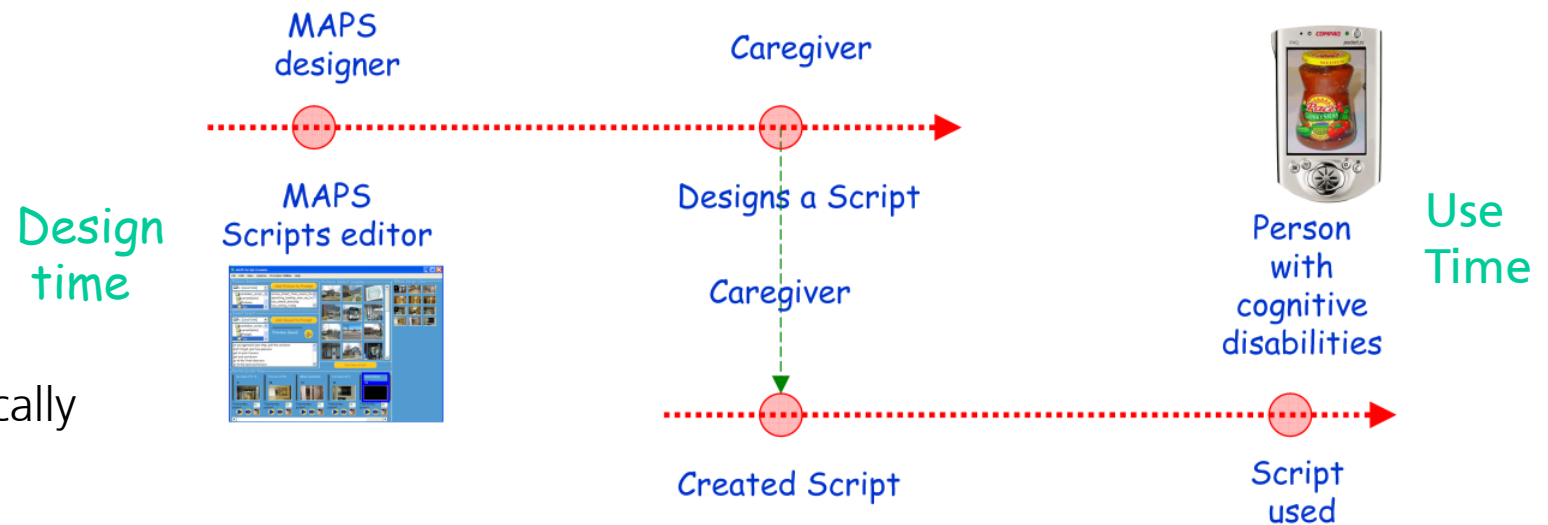
Metadesign examples

– High level scripting languages

– Blogs / Wikis / Social Networking Apps.

– Web based Collaborative tools

– Buildings

– More examples…..

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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

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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

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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

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MAPS

- Prompting as task support

  - Scripts of prompts (prompt = image & voice)

  - Internal scripts / traditional use

  - External scripts & hand held computers

Environment Home	1-Independent
Activity Making a Sandwich	2-Model
Student_____ **Please note kind of sandwich**	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
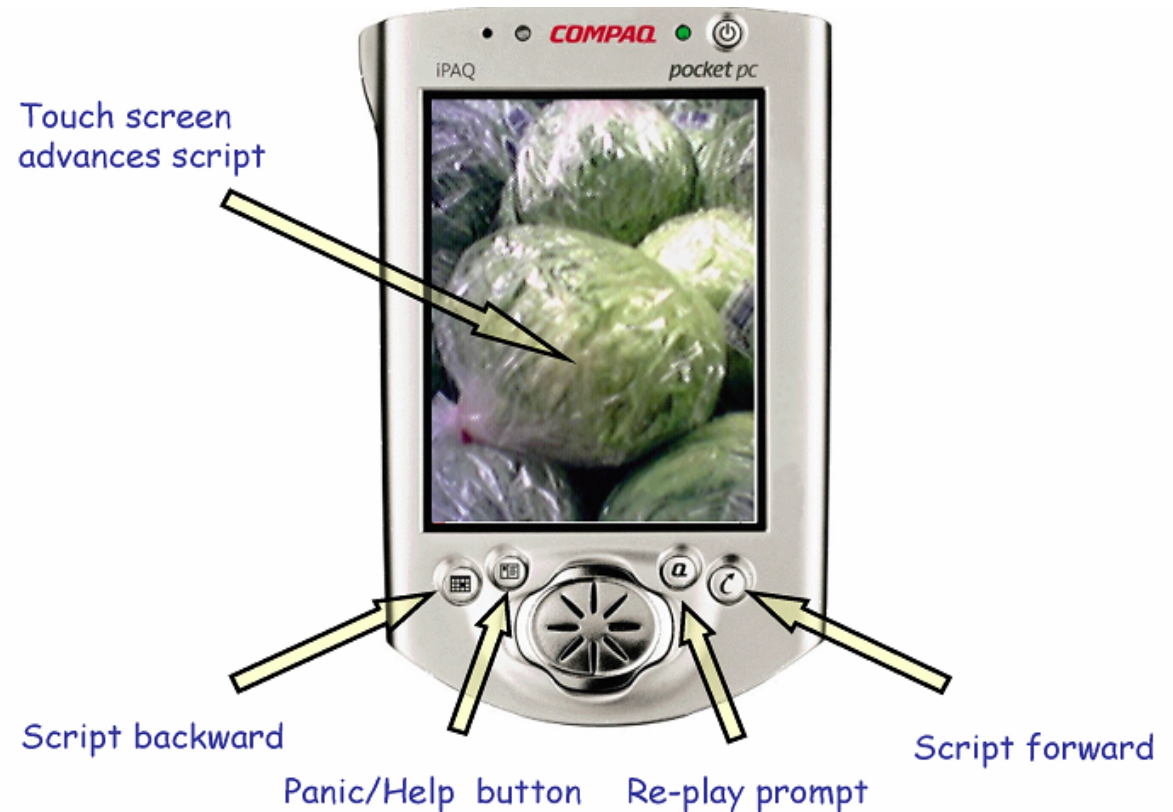
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Editor

- Caregiver as programmer

- Usability

- Putting the right amount of domain in it

- Changeable scaffolding

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Prompter

- Toasterize PDA

- 5 controls

- Stored on sd memory

- Mp3 player

Touch screen advances script

Script backward

Panic/Help button

Re-play prompt

Script forward

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MAPS users

– Persons with cognitive disabilities

– Caregivers

– Dyad - same data different interfaces

– Task changes
- From: memorization of steps and sequence
- To: using a prompter

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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

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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

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EU4ALL

A European Unified Approach for Assisted Lifelong Learning
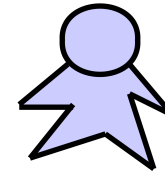A EC project 2006-2009

EU4ALL

– Content personalization

– Repositories of pedagologial content

– Content replacement not adaptation approach

– User requests a unit of educational content as part of a class

– EU4ALL provides the user personalized content

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Deep personalization is dependent on three things:

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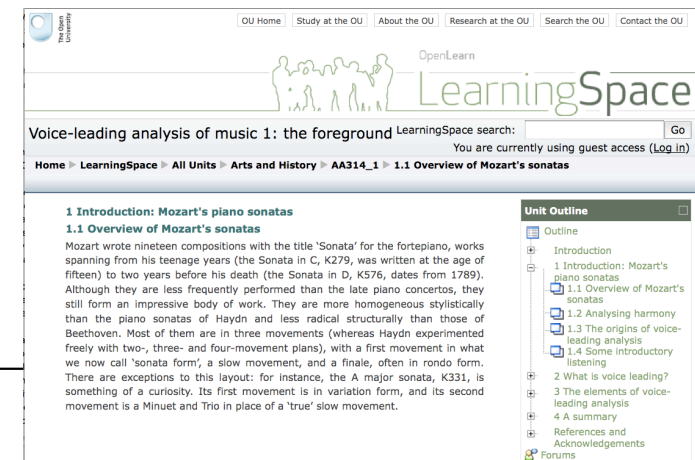 - Preferences in adaptation
- **The context**
  - The user agent
  - The environment (network accessibility, temperature, light)
  - Local availability of resources (I.e. printers, Java, browser)
- **The content material or task**
  - Accessibility qualities
  - Display specifics I.e. mime type
  - Network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

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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

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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)

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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

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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?

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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?)

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Questions?

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