Creativity Support Tools: A Grand Challenge for HCI

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HCIL

Interdisciplinary research community
- Computer Science & Psychology
- Information Studies & Education

(www.cs.umd.edu/hcil)

Crisis: Innovation & Creativity Skills

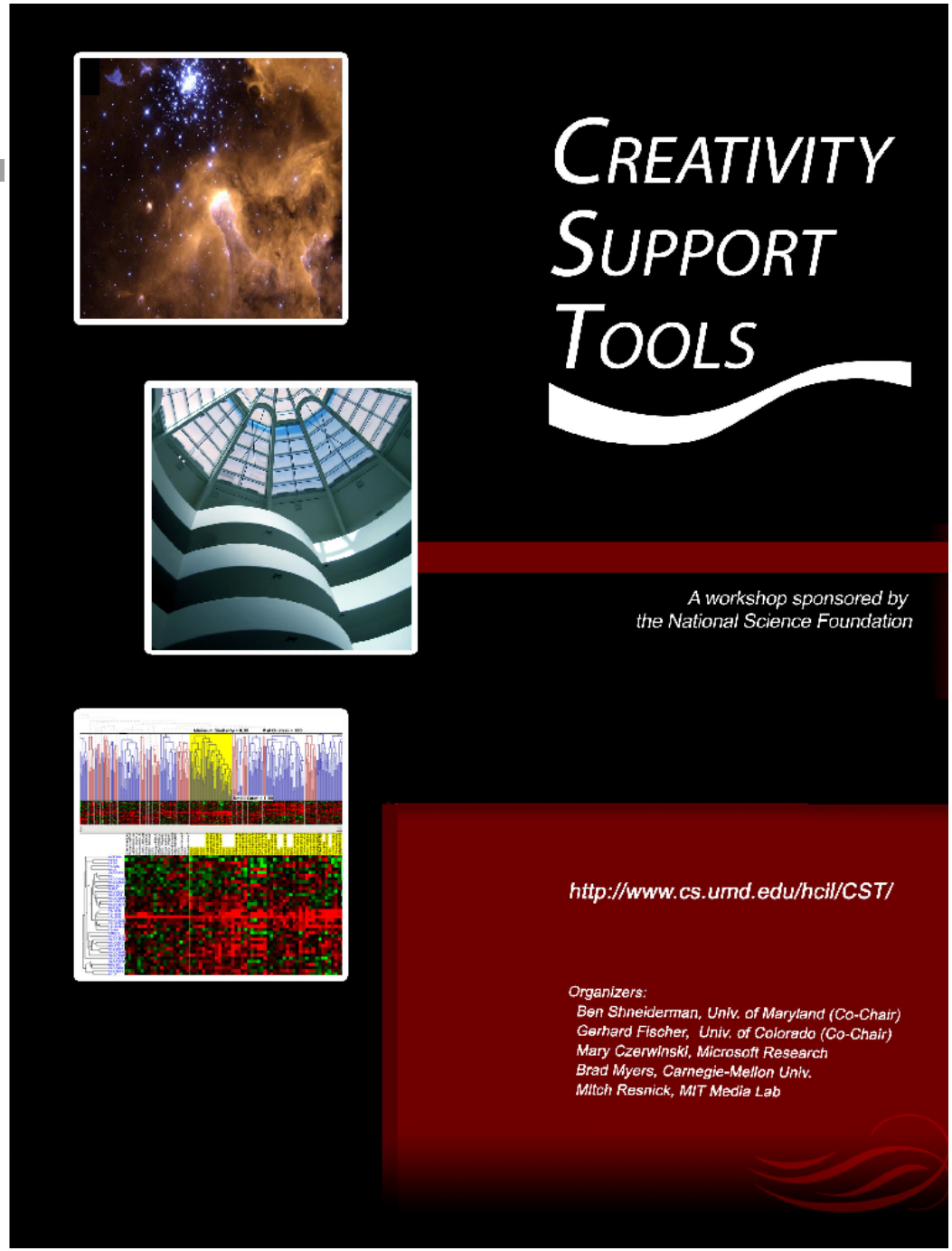
The workforce of the future requires people who have:

- strong communication skills
- ability to work collaboratively
- ability to manage ambiguity
- strong problem solving skills
- ability to rapidly learn new skills

http://innovateamerica.org/
http://www.compete.org/

National Science Foundation Sponsored Workshop

June 13-14, 2005
Washington, DC



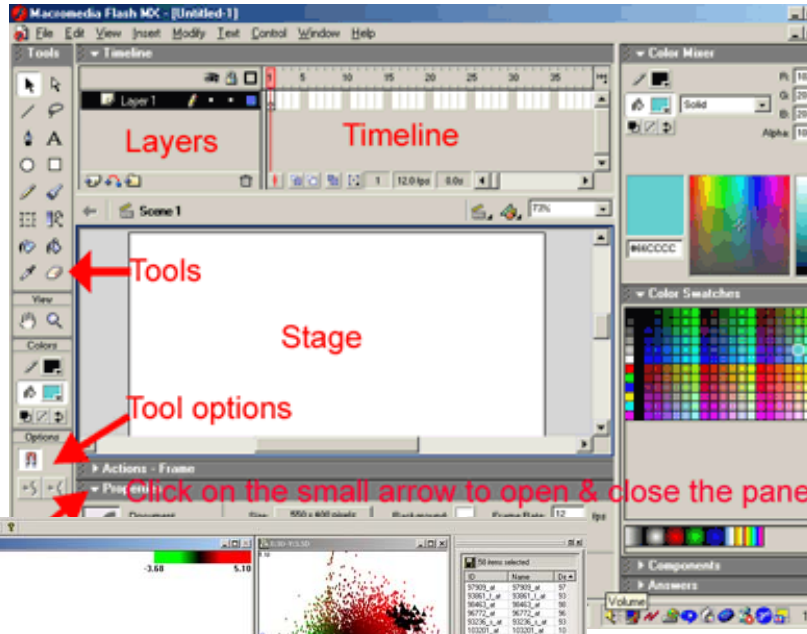
Outcomes by quotes

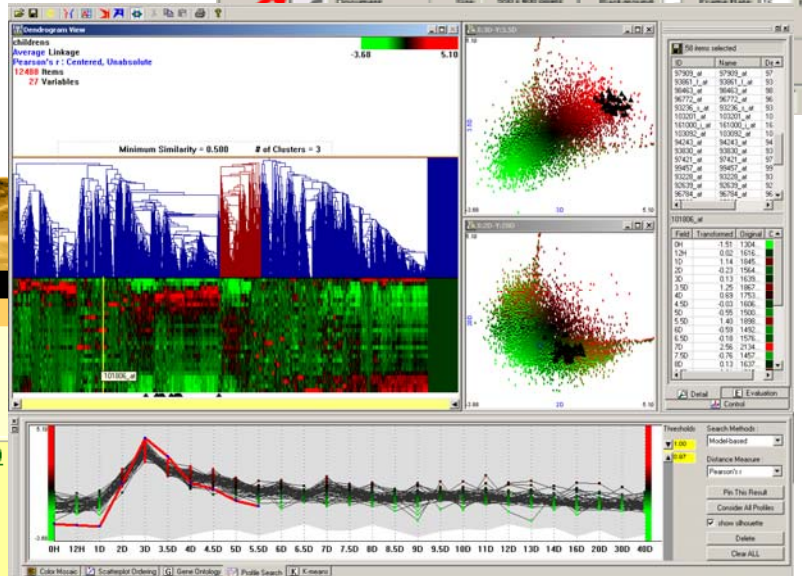
- “I have been studying collaboration for 20 years, but have only thought of creativity for 2 hours.”
- “Absolutely the most stimulating meeting I have been to in a long time.”
- “very stimulating and energizing … I had trouble falling asleep… because my head was filled with new ideas…”

Creativity Support Tools: Goals

More people, more creative, more of the time

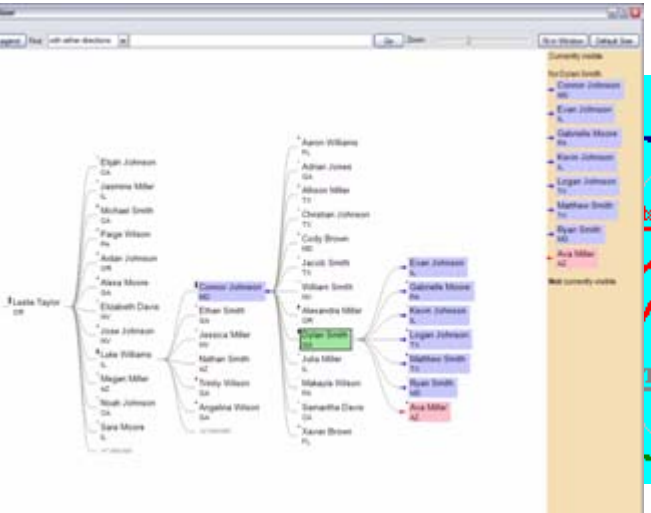
- Software & other engineers, scientists, architects, product & graphic designers, educators, students, new media artists, musicians, composers, writers, poets, screenwriters,. . .

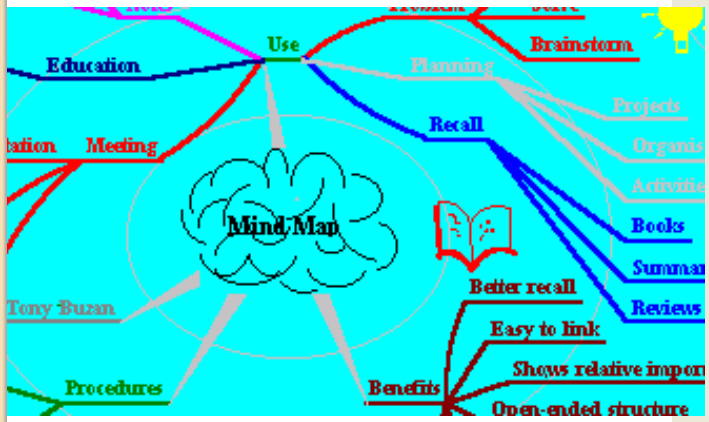


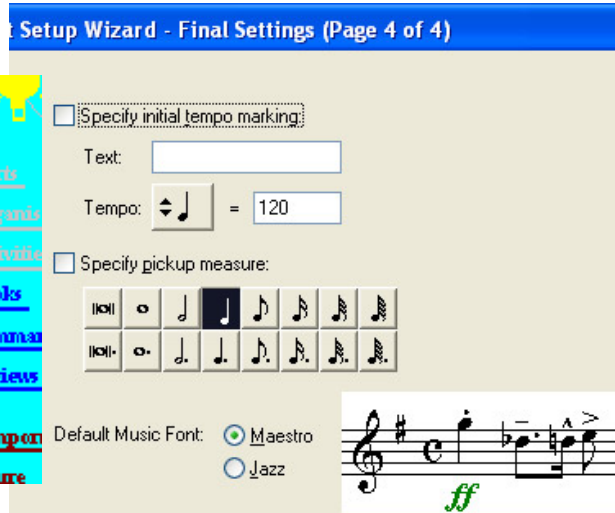


Creativity Support Tools: Goals

- Revolutionary breakthroughs, paradigm shifts
- Evolutionary, normal science, product design, engineering, music & art. . .
- Impromptu everyday creativity





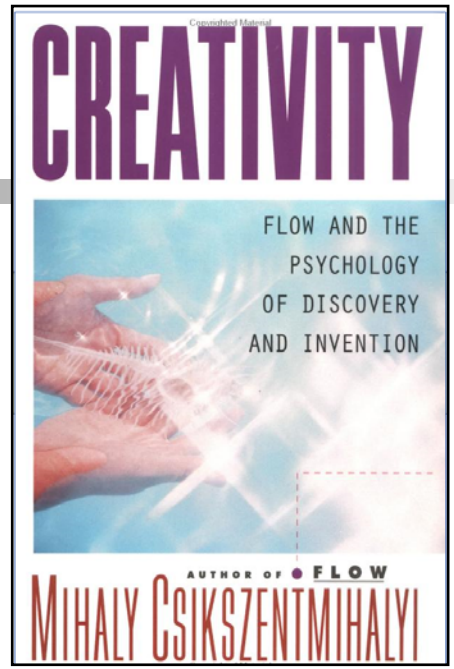


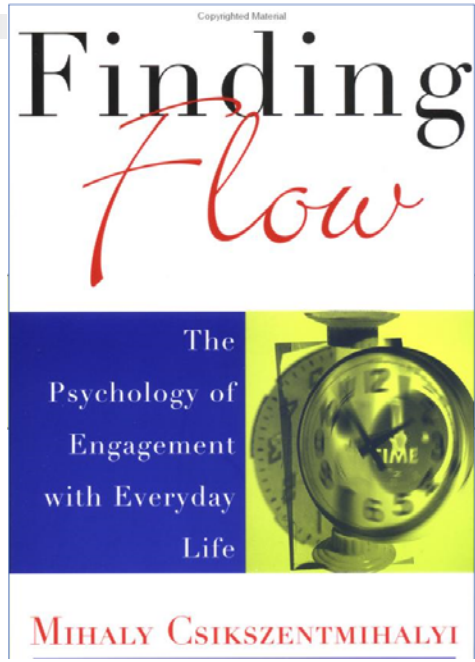
Key Sources

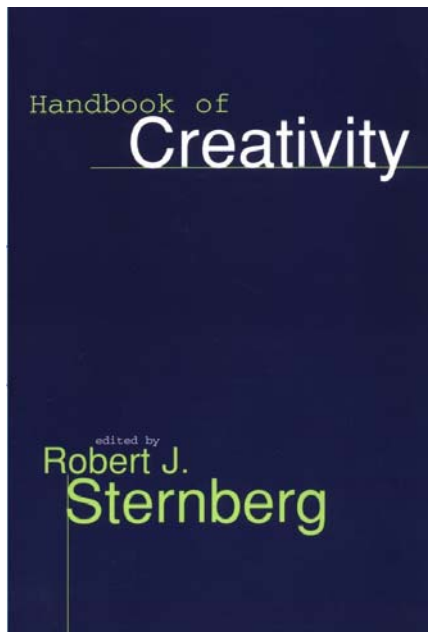
- **Csikszentmihalyi:**
  ***Creativity* (1996)**

  ***Finding Flow* (1997)**

- **Sternberg (Editor):**
  ***Handbook of Creativity* (1999)**

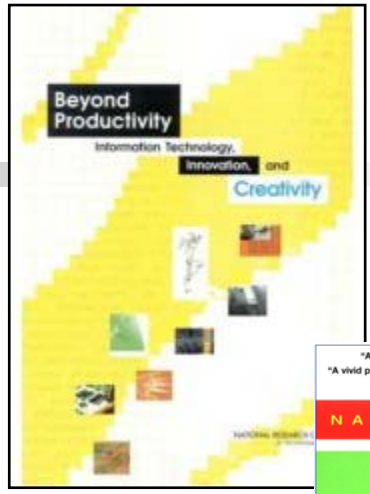




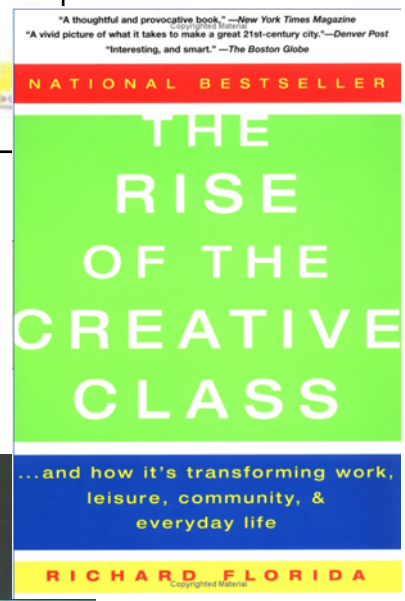


Key Sources

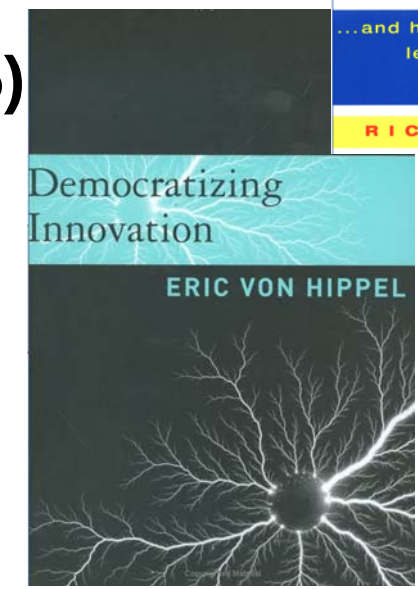
- **National Academy of Sciences:**
  ***Beyond Productivity: Information Technology, Innovation and Creativity* (2003)**



- **Florida:**
  ***Rise of the Creative Class* (2002)**
  ***Flight of the Creative Class* (2005)**



- **von Hippel:**
  ***Democratizing Innovation* (2005)**



International Research Efforts (Sample)

UK: Creative Industries Mapping Document

UK: National Endowment for Science, Technology & the Arts

UK: EPSRC Culture and Creativity Networks

Australia: Synapse: Collaboration between Art & Science

Hong Kong: Baseline Study on HK's Creative Industries

Japan: Status of Creative Industries in Japan and Policy Recommendations for Their Promotion

Brazil: FORUM on Creative Industries: Shaping an International Centre

Canada, Austria, Germany, Netherlands, Hungary, . . .

Structuralists: A plan, method, process

- Polya's four steps in *How to Solve It* (1957):
  - Understanding the problem
  - Devising a plan
  - Carrying out the plan
  - Looking back
- Couger (1996) reviews 22 "creative problem solving methodologies"
  - Preparation
  - Incubation
  - Illumination
  - Verification

Structuralists: A plan, method, process

- Atman's design steps:
  - Problem definition – identify need
  - Gather information
  - Generate ideas – brainstorm & list alternatives
  - Modeling – describe how to build
  - Feasibility Analysis
  - Evaluation – compare alternatives
  - Decision – select one solution
  - Communication – write or present to others
  - Implementation

(Atman et al., *Design Thinking Research Symposium 2003*)

Inspirationalists: Aha, Aha, Aha!

- Free associations
  - Brainstorming, ideation
  - Thesauri, photo collages
  - Random stimuli, inkblots
- Breaking set
  - Getting away to different locations
  - Working on other problems
  - Meditating, sleeping, walking
- Visualization
  - 2-d networks of ideas
  - Sketching

Situationalists: context, community, collaboration

- Personal history
  - Family history, parents, siblings
  - Challenging teachers, inspirational mentors
- Consultation
  - Peers and mentors
  - Early, middle and late stages
  - Information and empathic support
- Motivations
  - Fame, legacy, admiration
  - Competition

Csikszentmihalyi's book *Creativity* (1993)

- **1) Domain**: e.g. mathematics or biology
  "consists of a set of symbols, rules and procedures"

- **2) Field**: "the individuals who act as gatekeepers to the domain...decide whether a new idea, performance, or product should be included"

- **3) Individual**: creativity is "when a person... has a new idea or sees a new pattern, and when this novelty is selected by the appropriate field for inclusion in the relevant domain"

Eight Activities

- Searching & browsing digital libraries
- Consulting with peers & mentors
- Visualizing data & processes
- Thinking by free associations
- Exploring solutions - What if tools
- Composing artifacts & performances
- Reviewing & replaying session histories
- Disseminating results

(Creating creativity: User interfaces for supporting innovation *ACM TOCHI*, 3/2000)

Evaluation Methods : Controlled Experiments

- Specify users and tasks
- 2+ treatments of independent variable
- Predict and measure dependent variables
  - time to learn
  - speed of performance
  - rate of human errors
  - human retention over time
- Assess subjective satisfaction

  (Questionnaire for User Interface Satisfaction)

Evaluation Methods: Usability test

- Specify users and tasks
- 5-12 users carry out tasks
- Researchers observe and record problems
- Report to developers ranking
  - Severity of problem
  - Difficulty of revision
- Iterative process for product development

Evaluation Methods: Ethnographic

- Specify users and tasks
- Observe, interview, survey, log usage
- Plan for longitudinal study of 3-10 users
- Novices and domain experts
- Consider impact:
  - Social
  - Organizational
  - Cultural context

Evaluation Methods: Ethnographic

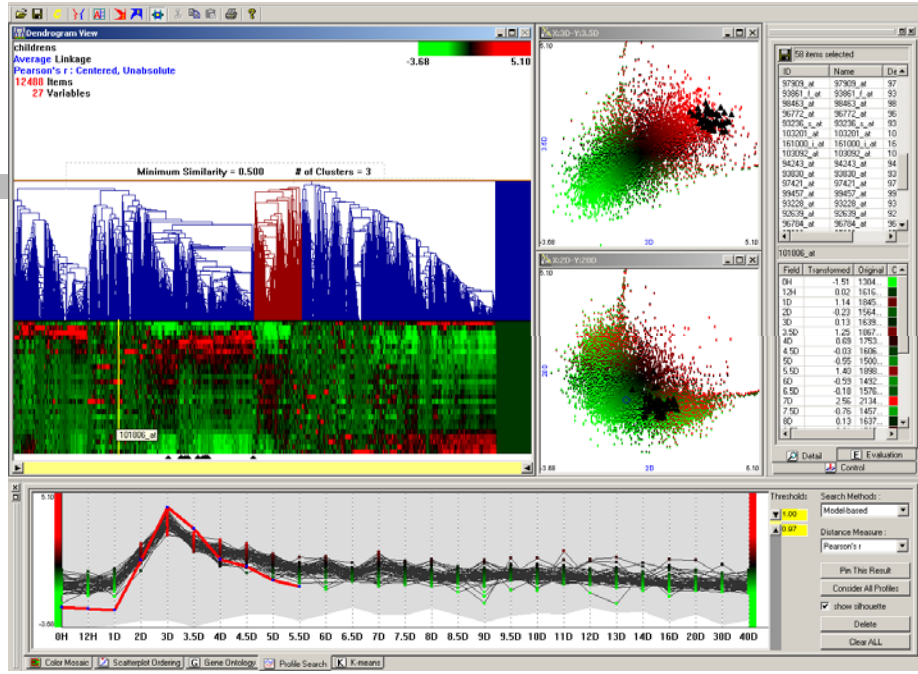
- Multi-Dimensional
- In-depth
- Long-term
- Case studies

Evaluation Methods: Ethnographic

- **M**ulti-Dimensional
- **I**n-depth
- **L**ong-term
- **C**ase studies

MILCs

MILC example



- **Evaluate Hierarchical Clustering Explorer**

- **Focused on efficacy of rank-by-feature framework**
- **3 case studies (molecular biologist, statistician, meteorologist) 4-8 weeks**
- **57 email surveys**
- **Identified problems early, gave strong positive feedback about benefits & research results**

Seo & Shneiderman, *IEEE TVCG* 12,3, 2006

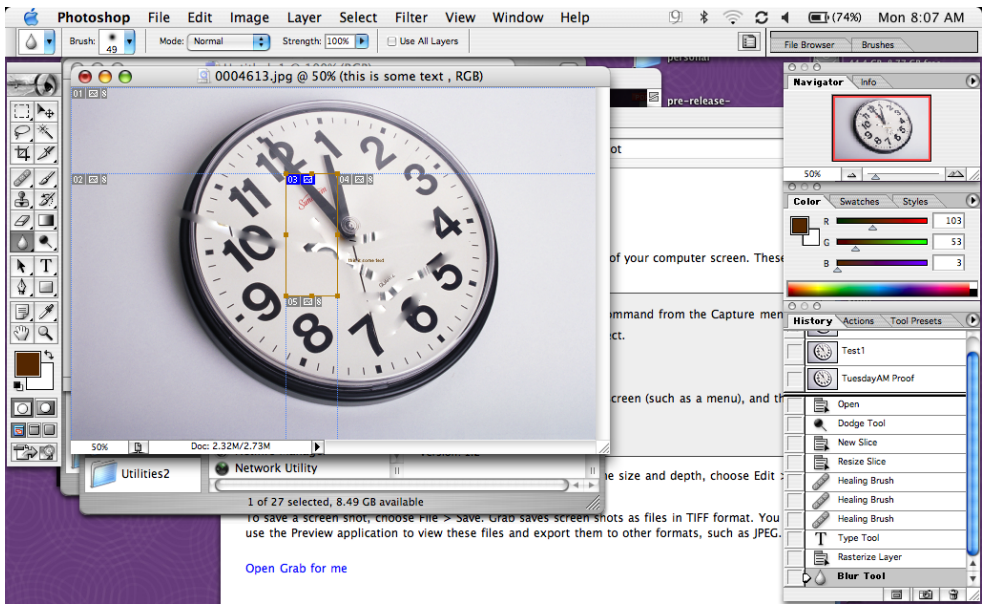
Guidelines for Creativity Support Tools

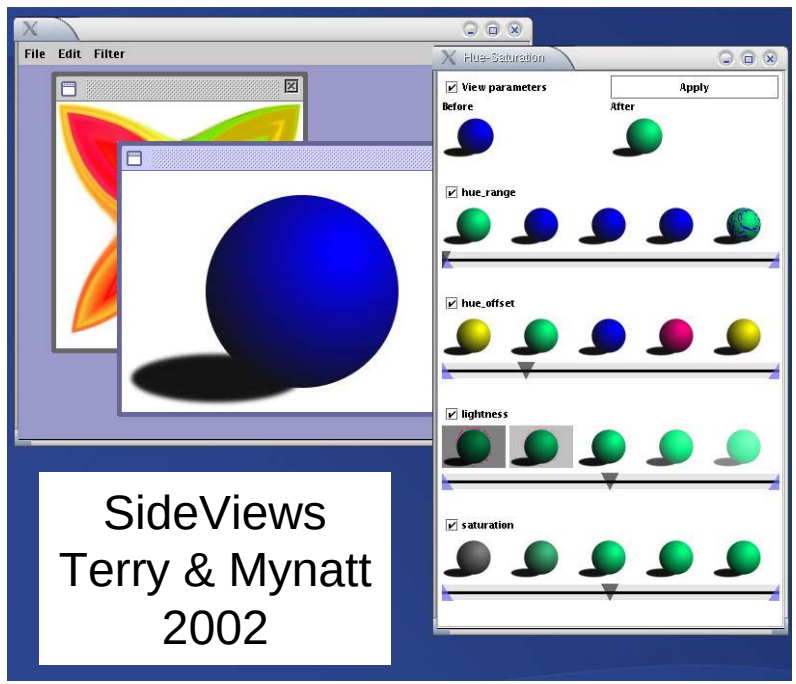
Support exploration & collaboration

Support many paths & many styles

Low threshold, high ceiling & wide walls

… and more



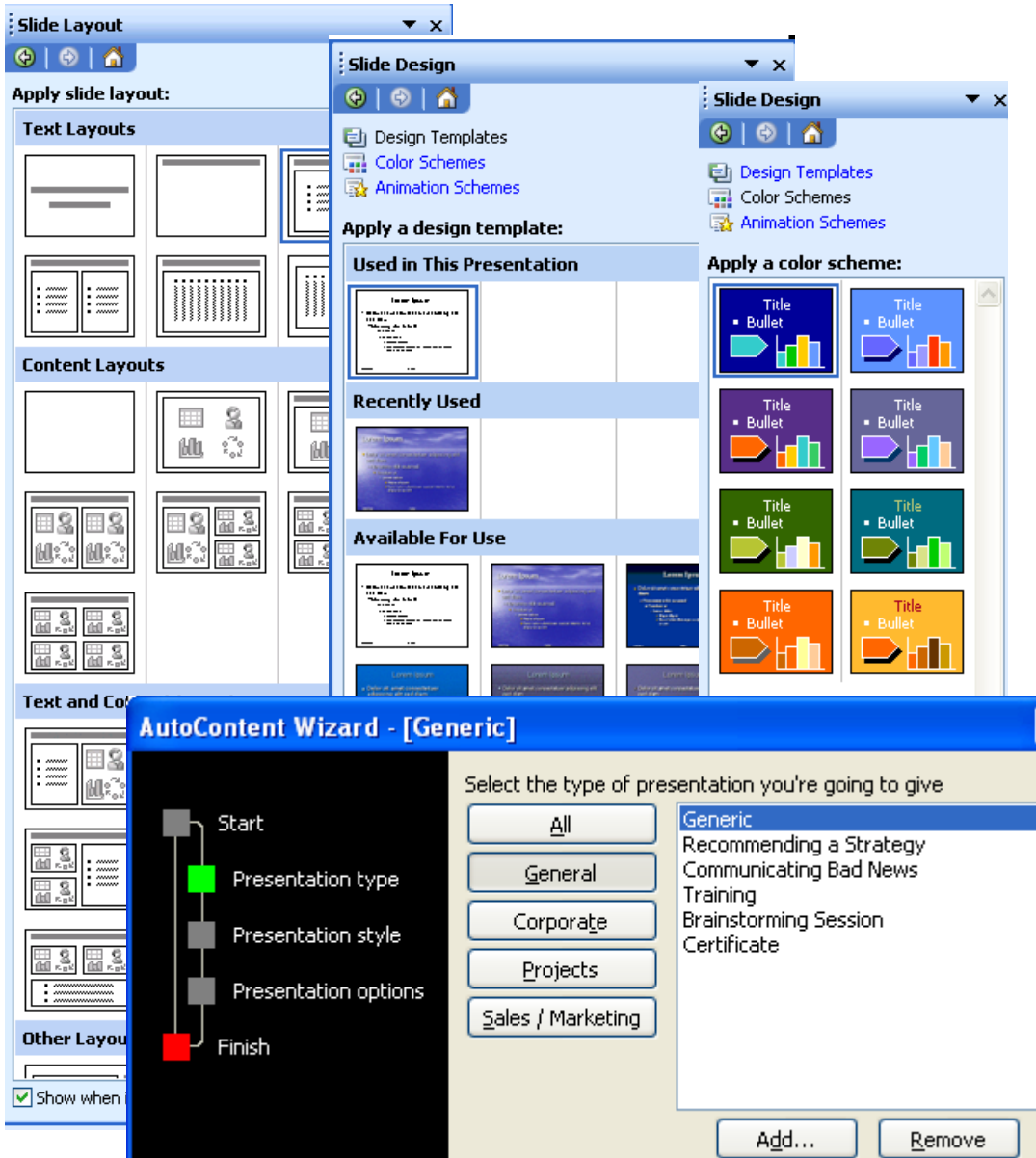


SideViews
Terry & Mynatt
2002

Guidelines for Creativity Support Tools

Initiate by:

- Exemplars
- Templates
- Processes



What now?

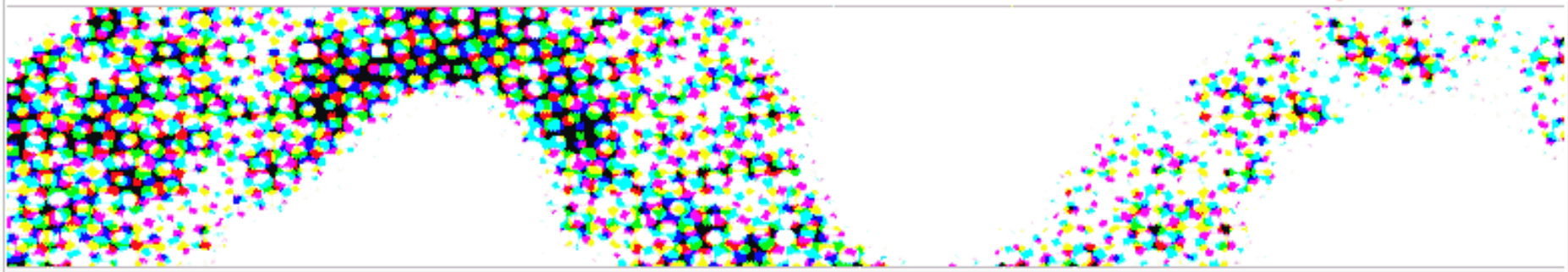
- National Science Foundation
  - Incorporate creativity in existing programs
  - Encourage new program on:
    Software Tools & Socio-Technical Environments to Enhance Creativity
- Colleagues
  - Refine research methods: Multi-dimensional In-depth Long-term Case-studies (MILC) (“Clinical trials” $100M for 3 years)
  - Develop dramatically improved software tools

CC2007

6th Creativity & Cognition Conference

Seeding Creativity: Tools, Media, and Environments

June 13-15, 2007, Washington, DC USA



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Important Dates

Papers Deadline:	December 15, 2006
Notification:	February 19, 2007
Revised papers:	March 19, 2007
Conference:	June 13-15, 2007

http://www.cs.umd.edu/hcil/CC2007/

re two elegant evening receptions at
DC locations:
the National Academy of Sciences (June 13) and Corcoran Gallery of Art (June 14)

Creativity Challenges

- Evolve new theories: incorporating social, technical, and organizational dimensions
- Identify the role of creativity in *all* disciplines
- Propose radically new individual *creativity support tools*
- Design *socio-technical environments* to enhance group creativity

Take Away Messages

- New research direction is emerging
- Dramatically improved creativity support tools are possible

- Multi-dimensional in-depth
  long-term case-studies (MILCs)
- Guidelines for design are emerging

www.cs.umd.edu/hcil/CST

www.cs.umd.edu/hcil/CC2007