Virtual science: Lessons from the UARC experience

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Outline

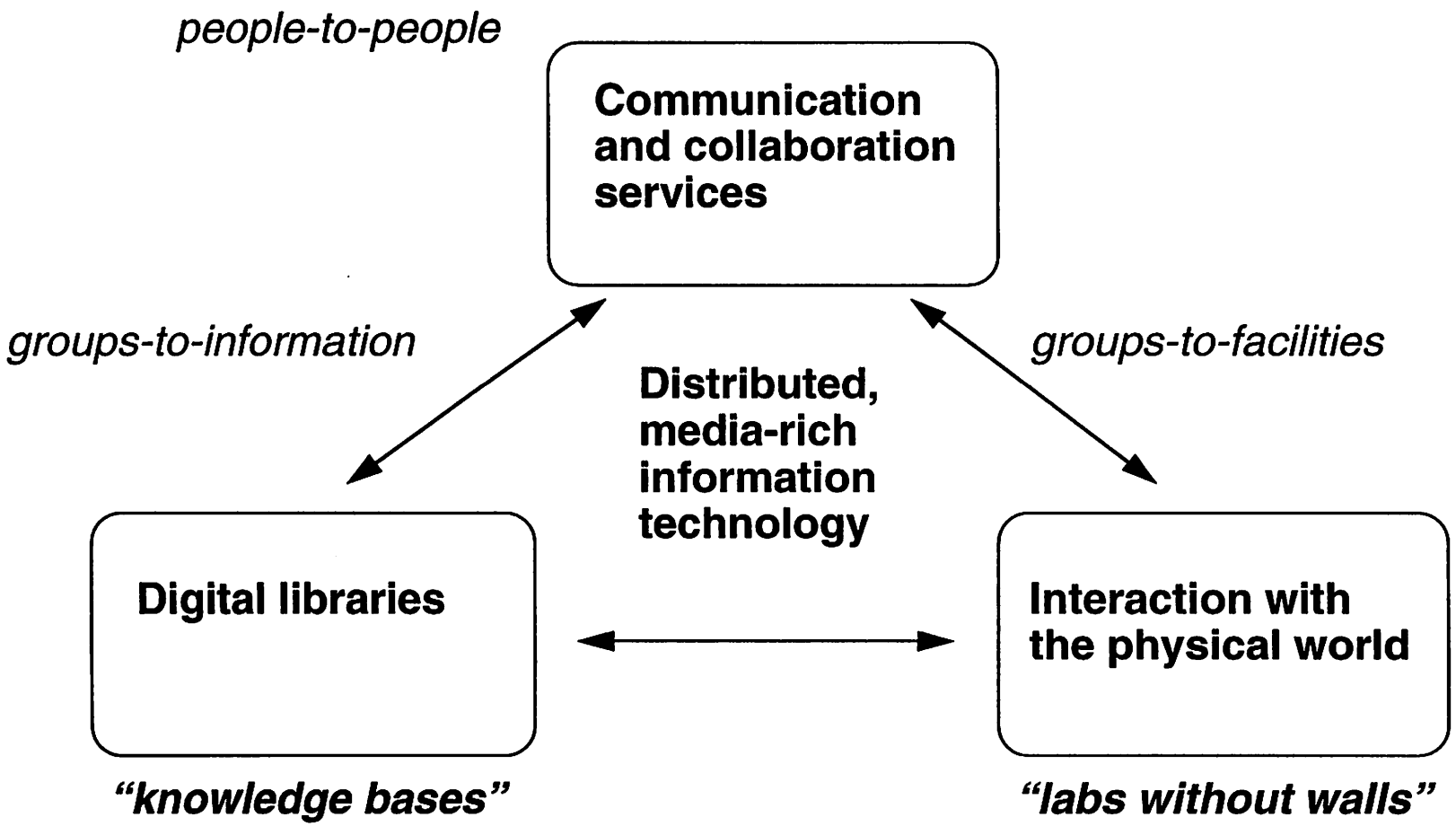
I. The collaboratory concept

II. UARC design philosophy

III. Lessons from the UARC experience (so far...)

IV. Future directions

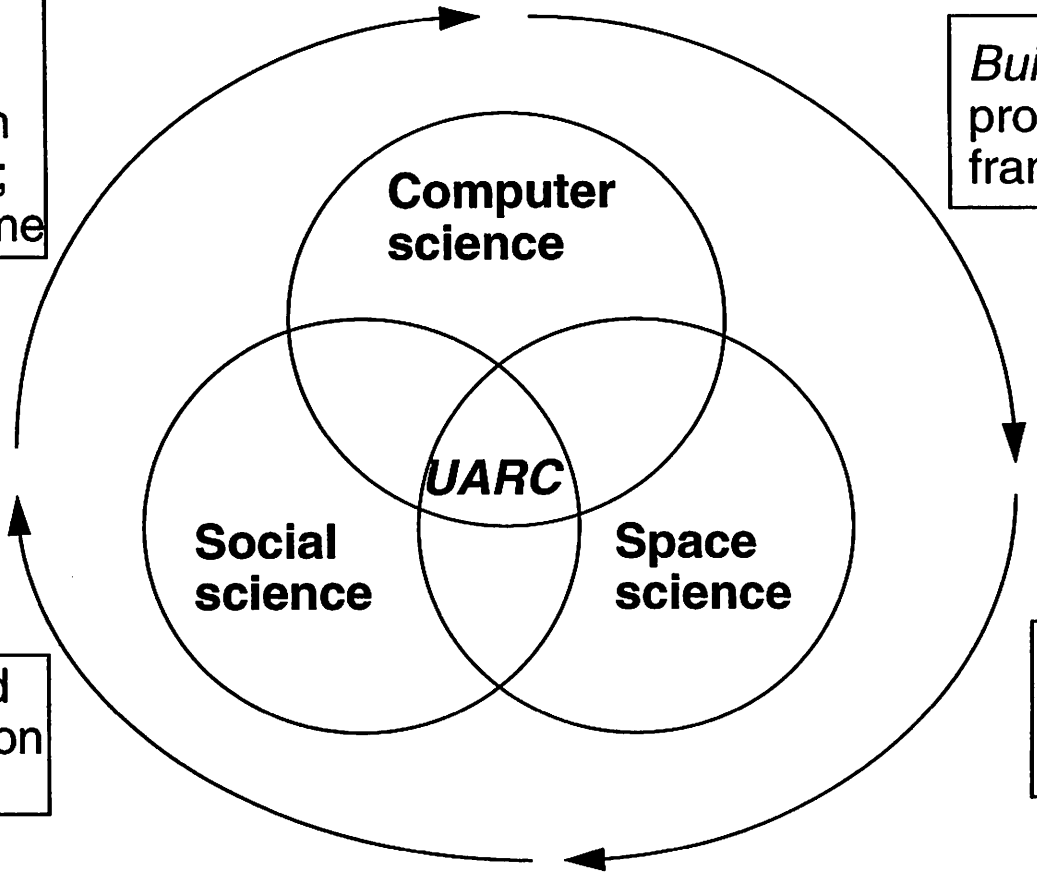
The collaboratory concept



UARC design philosophy

Conceptualize: observe and define objects in current practice; establish baseline

Build: rapid prototype in OO framework



Modify: extend design, evolution

Trials: Deploy, use, evaluate

Multi-disciplinary team ("Collaborative coalition")

Lessons from the UARC experience

Lesson 1: Collaboration over real-time data is not the most important component of current research practice among space scientists

Mean percent of effort allocated to research activities (n=65)

Activity	Percent of effort
Data reduction	36
Planning	19
Data collection	13
Modeling	12
Theory development	11
Training	10
Instrument development	8

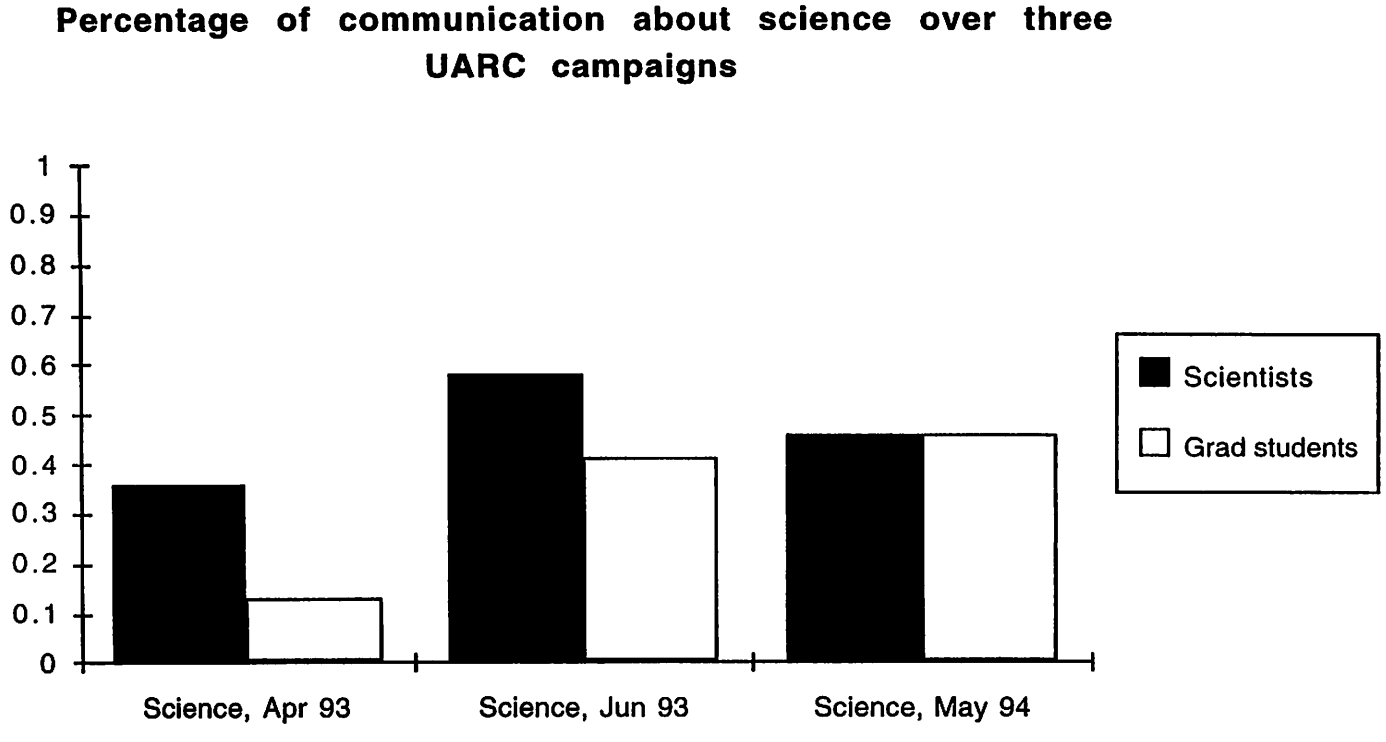
Lesson 2: Multi-user access to multi-instrument platforms is useful

Mean percent of data use by data source (n=65)

Data source	Percent of data use
Ground, operator	44
Ground, unattended	38
Spacecraft	32
Other	8

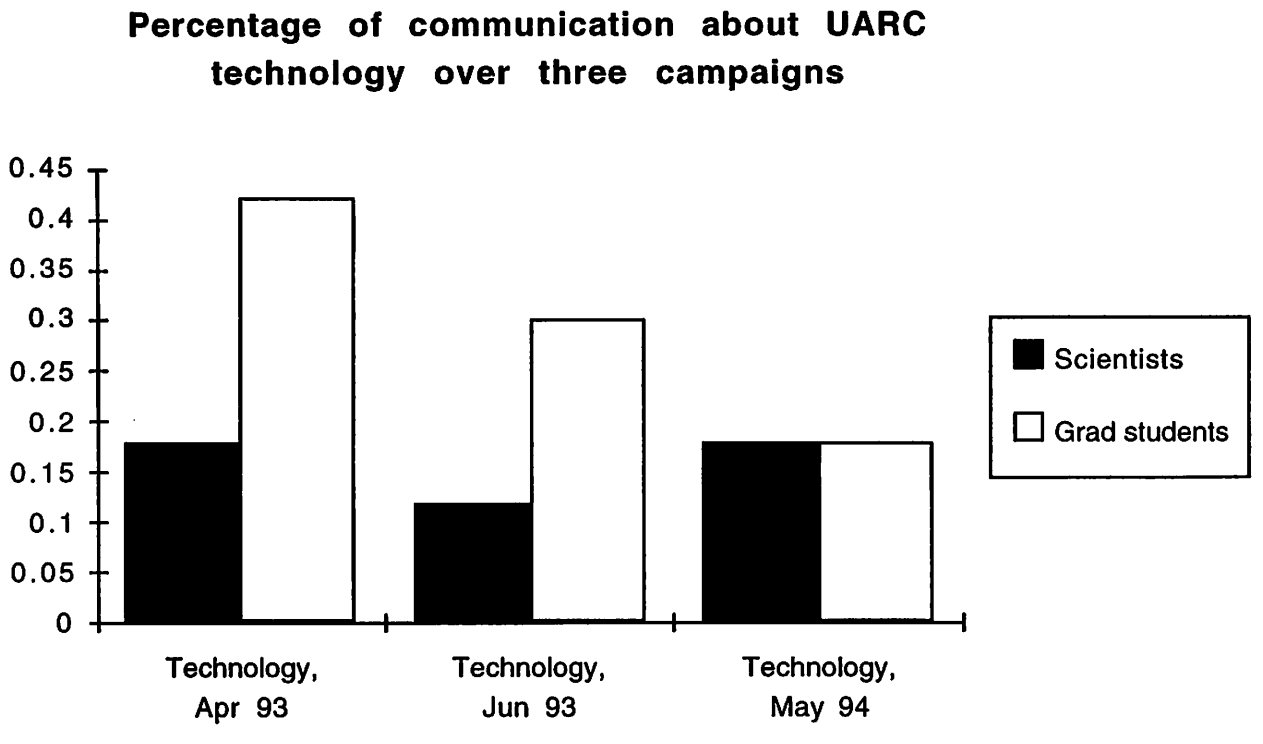
Lesson 3: UARC is a powerful educational tool

Proportion of scientist and graduate student communication about science during three campaigns: April, 1993; June, 1993; and May, 1994



Lesson 4: The UARC interface is less obtrusive over time

Proportion of scientist and graduate student communication about UARC technology during three campaigns: April, 1993; June, 1993; and May, 1994



Lesson 5: Users report that UARC use has positively changed their research practices

Senior scientist -- Watching the observations on UARC adds new features to my work. When you sit there and watch in real-time, you develop your own expectations and predictions, which are then validated or invalidated. When you watch a campaign this way, for some reason, you remember interesting situations better and you can recognize them them easier later on.

Graduate student -- I enjoy talking to Peter *[Stauning]* on the system. Peter provides answers for me when Bob *[Clauer]* is unavailable. This is a good way to learn because I can try out an idea and get a response quickly about whether it is good or bad. Also, UARC gives me the chance to learn how to run experiments. It is good to watch Bob *[Clauer]* run one. Without UARC I doubt that I would have participated in an experiment this early in my graduate career.

Lesson 6: Use of UARC for retrospective, collaborative data analysis is a useful new application

Example -- March, 1994 "replay campaign"

Participants: Peter Stauning in Denmark; Rick Doe in California; Cesar Valledares in Massachusetts; Odile de la Beaujardiere and Bob Robinson in Washington, D.C.; Rick Niciejewski and Craig Rasmussen in Michigan; and Ted Rosenberg in Maryland

Instruments: ISR, IRIS, All-sky imager

Data: PATCHES campaign, February 7 to 9, 1994

Future directions

Planned UARC development (1994 to 1997):

- enhance capabilities for support of retrospective, collaborative science (e.g., Atul Prakash's effort to develop shared windows, pointers, and annotations)
- produce standard interface for adding additional instruments (e.g., effort directed by Terry Weymouth and Craig Rasmussen)
- expand educational use -- perhaps following Mike Kelley's recent classroom demonstrations with UARC
- generalize findings and specifications -- but NOT particular technology -- to other collaborative scientific applications (e.g., evolution of the PCO)