

Co-creating shared vision with external representations

Dr. Deana Pennington

Associate Professor, Dept. of Geological Sciences

University of Texas at El Paso

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The Socio-Environmental Challenge



Soc



Study comput

“First you must
your data to R
then we can u
machine learn

BLAH
BLAH
BLAH
BLAH
BLAH



ature

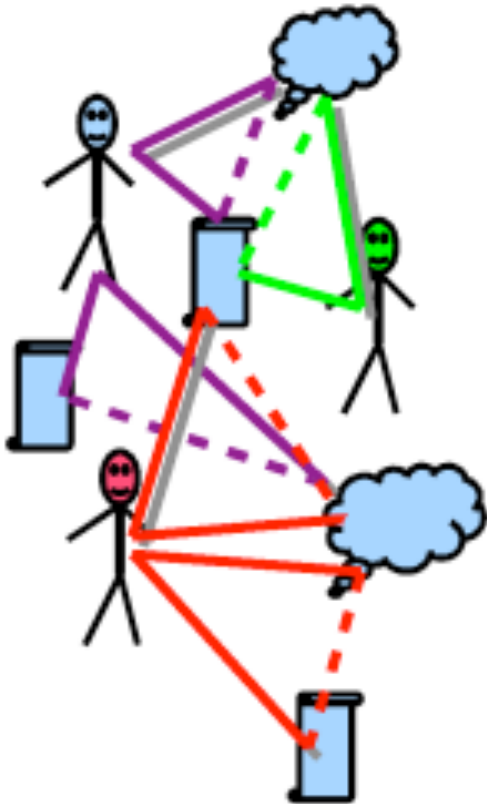
Technology and
productivity of a C3
grass...”





Need: Chaos Control

National Academy of Sciences (2015)
Enhancing the Effectiveness of Team
Science



1. **High diversity**
2. **Deep knowledge integration**
3. Large size
4. **Goal misalignment**
5. Permeable boundaries
6. Geographic dispersion
7. **Task interdependence**

Design Based Research

Boundary objects

Distributed
cognitive
systems

Group creativity

Cognition

Communities
of practice

Experiential learning

Organizational
learning

DESIGNED
COLLABORATIVE
ACTIVITIES



EXPECTED OUTCOMES
VS
ACTUAL OUTCOMES



Pennington 2008, 2010, 2011a, 2011b, 2013, 2016
Pennington et al. 2016; Gosselin et al. 2016; Bammer 2016

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Model-Based Reasoning

Models: Analogies, metaphor, thought experiments, visual models, and/or simulation models...

used for abstraction and communication of complex concepts

Model-based reasoning:

- Employing models to *invoke conceptual change* [e.g. learn]
- Reasoning by mental modeling possibly aided by external devices

(Nersessian 1999)

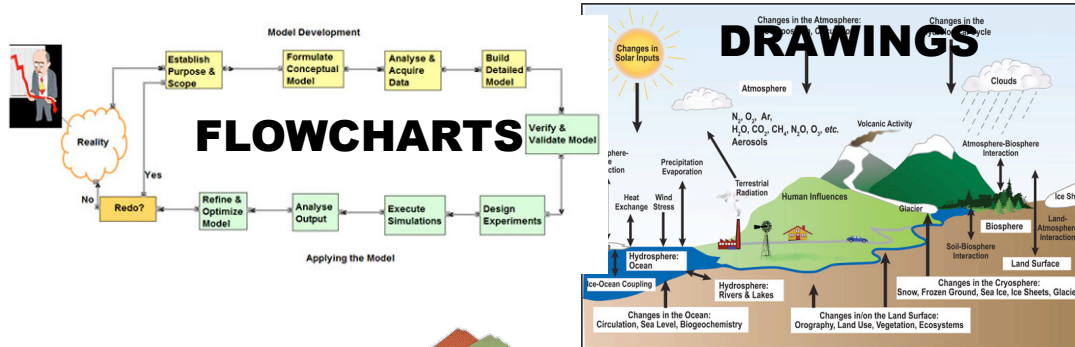
Models enable the offloading and summarizing of complex information so that individuals can *grasp* and manipulate more information [e.g. learn]

(Ifenthaler 2013)

External Representations as MEDIATORS

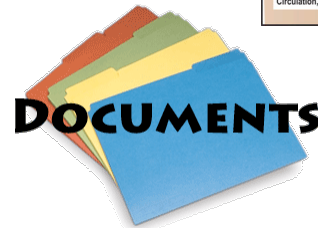
Boundary objects (Star and Griesemer 1989)
 Material artifacts (Hutchins 1992)
 Boundary negotiating objects (Lee 2007)
 Epistemic objects (Ewenstein and Whyte 2009)

Existing teams
 Static mediators
 Nascent teams
Dynamic mediators



INDIVIDUAL 1
 WORK

INDIVIDUAL 2
 WORK



The Generative Dance (Cook & Brown 1999)



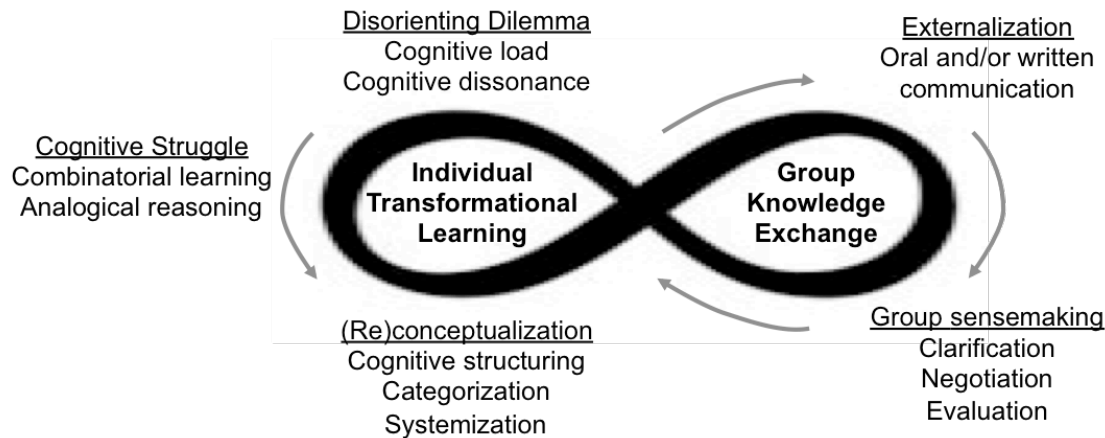
Mediated by
Boundary
Negotiating
Objects



GROUP
SHARED
VISION

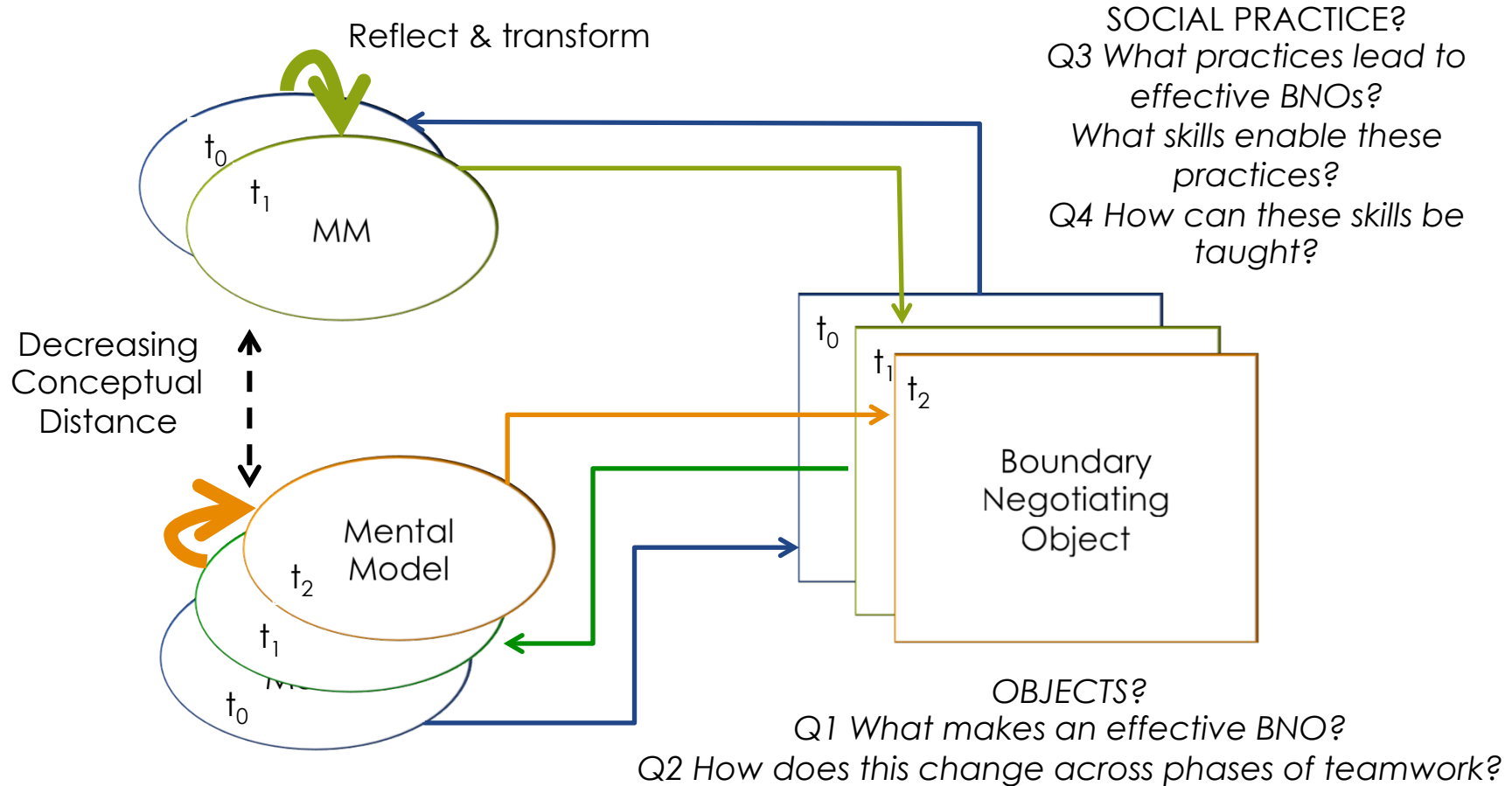
INDIVIDUAL
MENTAL
MODELS

Changed by
Learning



Co-created by
Reasoning
Together

Model Based Reasoning



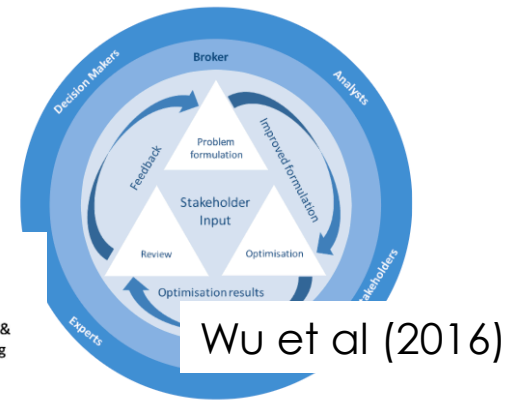
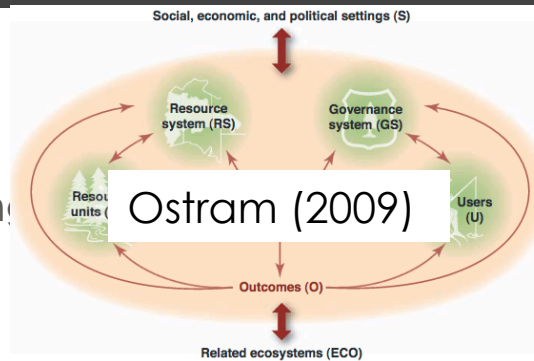
Q5 How can this new model be effectively disseminated to transform the way team science is conducted and taught?

Proposed Terminology

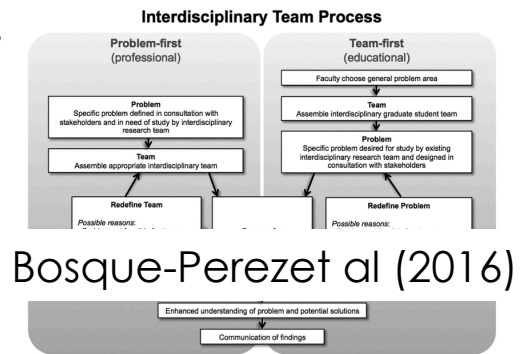
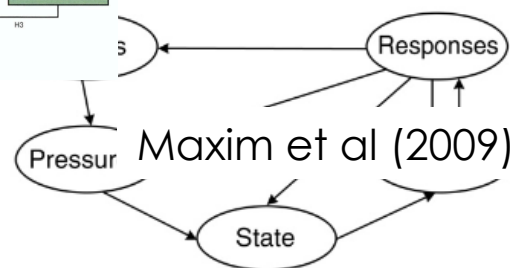
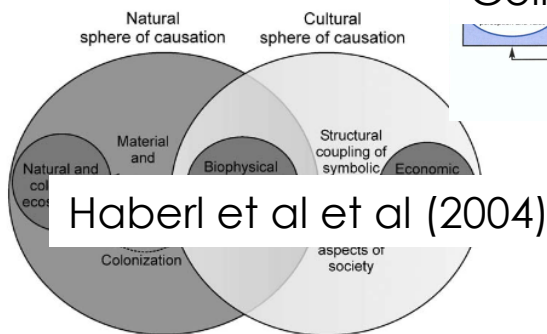
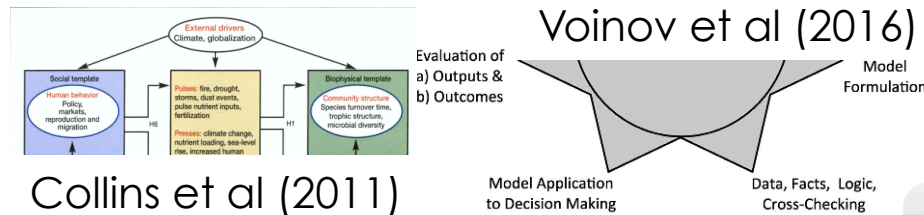
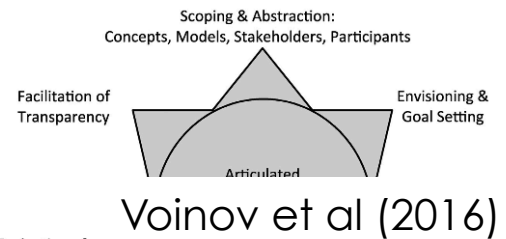
- A collaborative team **negotiating disciplinary boundaries**
- by invoking **model based reasoning** (Nersessian)
- using **boundary negotiating objects** (Griesemer and Star, Lee)
- Is one example of **macrocognition** (Fiore)

Macro-cognition in practice

- Collaborative modeling
- Integrated assessment modeling
- Stakeholder modeling
- Participatory modeling
- Mental modeling



Proposed conceptual framework for including stakeholder input for formulating living real-world optimisation problems.



EMBeRS Project

- Employing model-based reasoning in socio-environmental synthesis (EMBeRS)
- Two years of meetings at SESYNC (National Center for Socio-Environmental Synthesis)
- 2015-18 NSF NRT-IGE
- Presentation Wednesday afternoon



Conclusions

- We simplify the world through models – mental, conceptual, simulation, etc.
- Reasoning around external representation of models facilitates co-creation of a shared vision
- Interaction between externalizations and process within which they are embedded
- Better understanding => more effective team activities

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■ **REMEMBER EMBERS!**

