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Research Note

A novel method for assessing integration activities in landscape management

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HIGHLIGHTS

- Examines the relationship between before and after conditions for an integration activity.
- Uses influence diagrams to elicit mental models of researchers before and after.
- Field trips significantly changed researchers mental models.
- Successful integration research requires understanding what conditions need to change.

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ABSTRACT

Integrated research outcomes are considered necessary to manage uncertain and complex landscape problems; however the evaluation of integration activities has remained descriptive and unempirical. We experimented with a novel methodology to test the effect of an activity, 'field trip', on individual researchers' in a Murray-Darling Basin Research Program, Australia. Within a one month period, we conducted (before and after) interviews with researchers who either participated in the activity (experimental; $n = 7$), or not (control; $n = 4$), and, assisted them to generate an influence diagram to elicit their mental model. Analysis of quantitative and qualitative data indicates that the field trip enhanced participants' understanding of Program context and project integration. Participants' mental models were significantly ($p < 0.05$) changed after the field trip; no significant difference was observed in the control group. Our results suggest that field trips, as integrative activities, can have an influence on researchers' mental models however for the greatest effect they should be designed to accommodate; personal pre-conditions (e.g. knowledge and experience), expected change in these conditions and a desired integration outcome.

1. Introduction

Integrative research has been identified as essential in landscape management, because of the uncertainty and complexity of landscape problems. This requires integration of knowledge from land and water managers, planners and policy-makers and the natural and social sciences across different temporal, spatial and governance scales (e.g. Southern, Lovett, O'Riordan, & Watkinson, 2011). Yet, despite the burgeoning integration activity, little on-going evaluation of process and landscape outcomes occurs, leading to calls for improvements in integrative research evaluation (Huutoniemi, Klein, Bruunc, & Hukkinen, 2010; Klein, 2008).

Effective evaluation of integration outcomes requires understanding of: (1) the pre- or before conditions of the personal and social-ecological system; (2) the integration activity; (3) anticipated changes (for individuals and social groups); (4) post- or after conditions; and (5) desired outcomes (Stokols et al., 2003). Personal pre-conditions include existing knowledge, beliefs and experience; system pre-conditions include existing institutional, political or social structures. Integration activities are inter or intra personal events (e.g. meetings, workshops, field trips) that communicate and co-develop knowledge (e.g. ideas, theories, solutions) between researchers and stakeholders. Change from these activities is expected in the individual and social attributes

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Table 1
Participant information.

Participant	Type of scientist: discipline area	Research approach	History with MDB	Research project
A*	Life scientist: freshwater ecology	Applied & policy research	Yes	1
B*	Social scientist: economics	Applied research	No	2
C	Social scientist: economic geography	Applied research	No	2
D	Social scientist: economics	Pure research	No	3
E*	Life scientist: ecology	Applied research	Yes	4
F	Physical scientist: geology & geomorphology	Pure research	Yes	5
G	Physical & life scientist: chemistry, hydrology & ecology	Pure & applied research	Yes	5
H*	Social scientist: economics	Applied research	No	3
I*	Social scientist: humanities	Applied research	Yes	6
J*	Life scientist: ecology & hydrology	Pure & applied research	Yes	5
K*	Social scientist: social research	Applied research	Yes	7

* Asterisk denotes that participant took part in the field trip.

of researchers (Bergmann et al., 2012; Fry, 2001; Klein, 1990; Stokols, Harvey, Gress, Fuqua, & Phillips, 2005; Tress, Tress, vander Valk, & Fry, 2003). Individual attributes have affective (feelings/emotions), cognitive (intelligence, perception/information of an object), and conative (behavioural) components (Rokeach, 1973). Social attributes include relations of trust; reciprocity and exchanges; common rules, norms, and sanctions; and connectedness in networks and groups (see Pretty, 2003). Changes in the individual and social attributes of researchers leads to post-conditions in the personal and system conditions, which can support desired integrative outcomes (e.g. shared problem structuring, common language).

In general, integrative assessment occurs at the completion of a research program, and so change or outcomes cannot be attributed to specific activities or compared to existing or pre-conditions (e.g. Antrop & Rogge, 2006). Furthermore, integrative research programs with a large 'activity' component have demonstrated changes in social attributes, including increased levels of trust and engagement between researchers, but have failed to demonstrate individual change or the development of shared understandings of problems and solutions (Armstrong & Jackson-Smith, 2013). These results question the effectiveness of integration activities in changing individual attributes of researchers which are an essential contributor to successful integrative research outcomes (Huutoniemi et al., 2010).

The aim of this experimental study was to evaluate the effectiveness of a single integration activity (researcher field trip) in a large multi-project integrative program. The focus was to understand whether individuals change with respect to their understanding of (i) problem context and (ii) project integration. We used interviews and trialled the use of qualitative influence diagrams to elicit mental models (personal pre-conditions) of context and project-to-program integration. Mental models are frameworks that reside in the mind and organise information into patterns, generate causal connections and predications and solve problems (Johnson-Laird, 1983; Wynne, 1995). They are dynamic, personalised representations of the world that are based on an individual's knowledge, experience and beliefs and form the basis of their reasoning, decision-making and behaviour (Johnson-Laird, 2010; Jones, Ross, Lynam, Perez, & Leitch, 2011). The trialling of integration assessment using these methods is an innovative approach and our results are presented as initial proof-of-concept.

2. Methods

We elicited individuals' mental models, directly before and after the integration activity, through interviews and influence diagrams (Bryman, 2008). All respondents were academic researchers (at least 20% of their time) in the Murray-Darling Basin (MDB) *Futures* Collaborative Research Network, a research program of integrative land and water management focused on Australia's largest water catchment. The research program comprises 13 inter-related projects (covering ecological, historical, educational, social and economic aspects). Eleven program researchers participated in this trial and either undertook the 'field trip' (experimental; $n = 7$), or not (control; $n = 4$); all interviews were undertaken by the lead author, lasted approximately 1 h and were held in September 2013. Both groups were stratified so they shared similar characteristics: disciplinary backgrounds, project engagement and experience in the MDB (see Table 1). The number of research participants was limited by the availability of researchers in the interview 'window', 7 days before and after field trip; the availability of only one interviewer; and the total number of researchers on the field trip (maximum 14 eligible people, excluding logistic and management staff).

The principle aim of the field trip was to provide interpersonal (i.e. between people) structured events (presentations, farm tours, policy briefs, community insights) coupled with researcher-led reflective discussions. All events were focused on (1) understanding the context and drivers for change of the MDB social–ecological system, specifically around people, communities and policy influences; and (2) identifying cross-project links.

We tested change in researchers understanding of social–ecological system conditions (before and after) by asking respondents: what are the most important (e.g. social, economic, biophysical) features of the Murray-Darling Basin?

We tested the effectiveness of the field trip (activity) on changing individual attributes of researchers (i.e., their mental models) by using qualitative influence diagrams (e.g. variables linked by directional arrows), which can be used to structure and communicate thoughts and beliefs (Diffenbach, 1982; Fiol, 1992). The interview questions were: how will your research influence the MDB's future; which other projects do you interact with and how did the field trip influence you?

Each influence diagram was constructed of 25 predefined variables in five categories: future of the MDB (4 options), implementers of the future (8 options), tools for implementation (6), type of knowledge required (6) links to other projects in the Research program (1). Variables were sourced through literature review of program documents (e.g. research program summaries at http://www.canberra.edu.au/murray-darling-crn/projects) and tested in pilot interviews with three individuals associated with the Research program. An example of before and after influence diagrams is found in Fig. 1.

3. Analysis

We analysed the interviews through inductive thematic analysis, identifying themes in the data that relate to the research questions (Braun & Clarke, 2006). We used manifest coding to identify these themes (Charmaz, 2006; Klenke, 2008). We