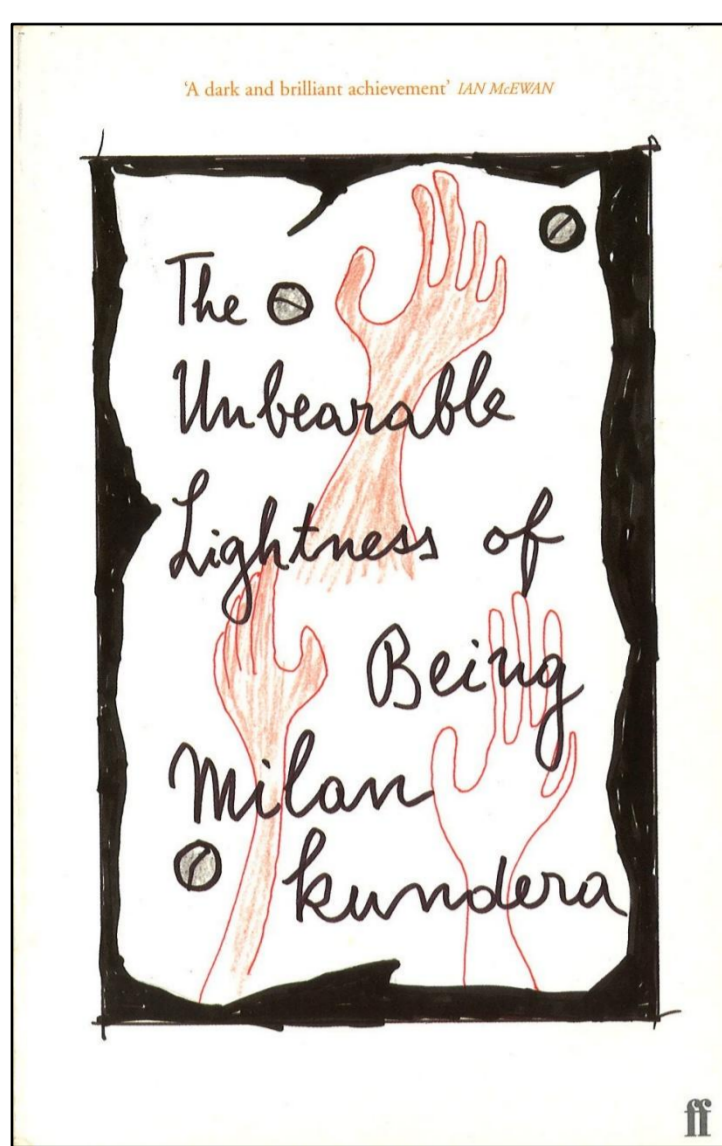


Model Histories: Generative Simulation Modelling and its Narrative Properties



The novel is ... an investigation of human life in the trap the world has become.

Kundera (1984)

We argue that their narrative properties mean 'generative' simulation models can also investigate this trap, and that these properties can be better utilized.

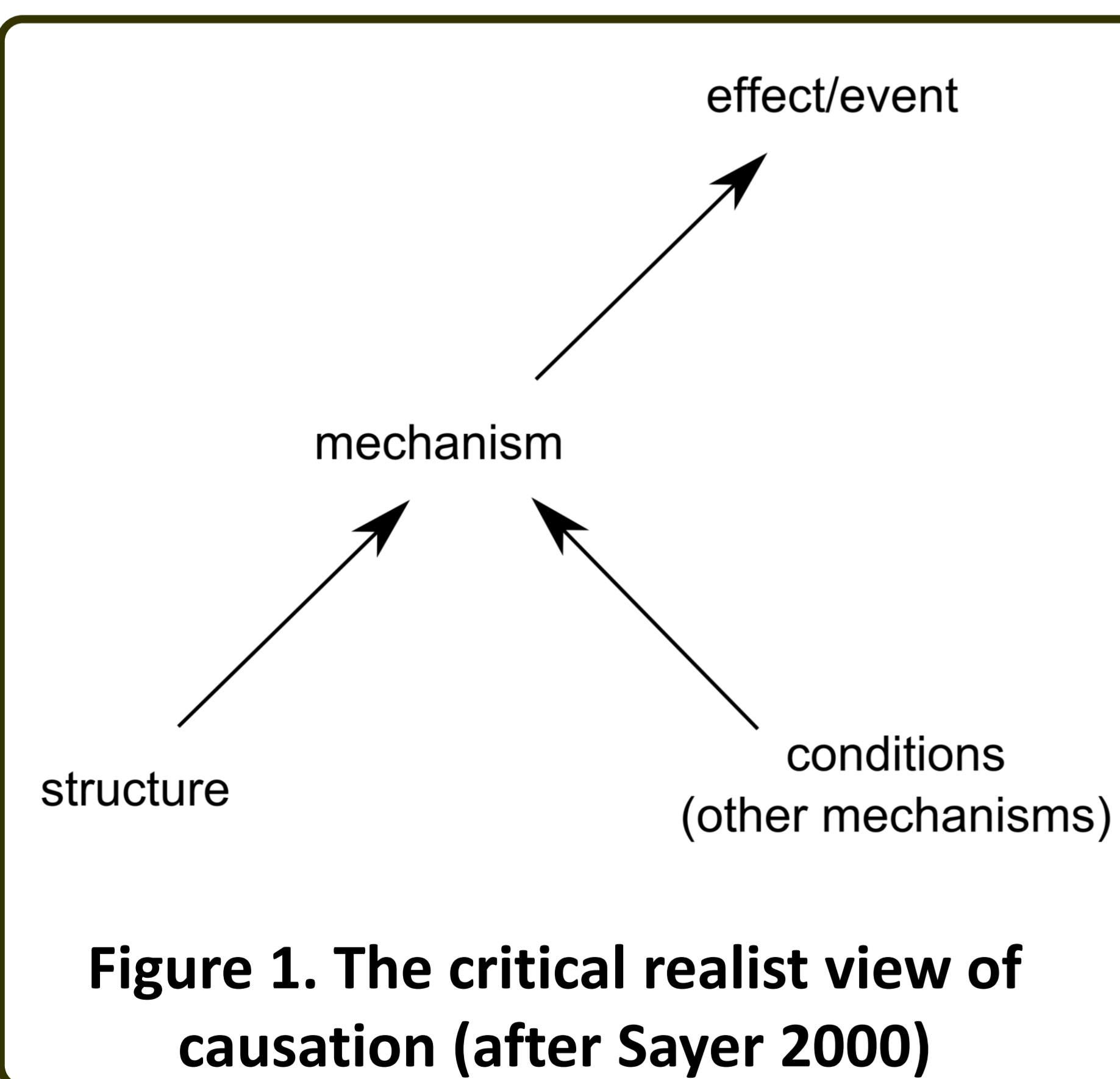
We suggest that dynamic, mechanistic modelling approaches have narrative properties that can complement quantitative analysis by:

- 1) demonstrating & illustrating the significance of mechanisms producing **emergent patterns**,
- 2) inspiring **users** to **reflect** more deeply on modelled system properties & potential futures,
- 3) providing a means to reveal the **model building process** and the route to discovery.

1) Emergent Patterns

Generative modelling tools provide the means to investigate sets of (micro) mechanisms that produce (macro) patterns of events that emerge through time from system structure and conditions.

The approach allows the investigation of alternative ways out of 'the trap the world has become' by examining potential effects of mechanisms activated by conditions contingent (neither necessary nor impossible) on multiple other interacting mechanisms. It is therefore useful given a **critical realist view of causation** (Fig. 1).



The narratives we envisage provide a formal, but non-technical, **representation of the history of modelled events**. Narratives:

- **illustrate** 'important' interactions
- **organize** events in a sequence
- suggest **causal** connections
- are **subjective**, but **consistent** with observations
- aid **interpretation**, **explanation** and **communication**

Narratives from generative simulation models that represent individuals' actions (e.g. **agent-based models**) can provide insights into how to improve the ability of individuals and groups to identify how their local actions (micro mechanisms), influenced and influencing others' actions (contingent conditions), **transcend scales** to affect system properties at a larger scale (macro effects).

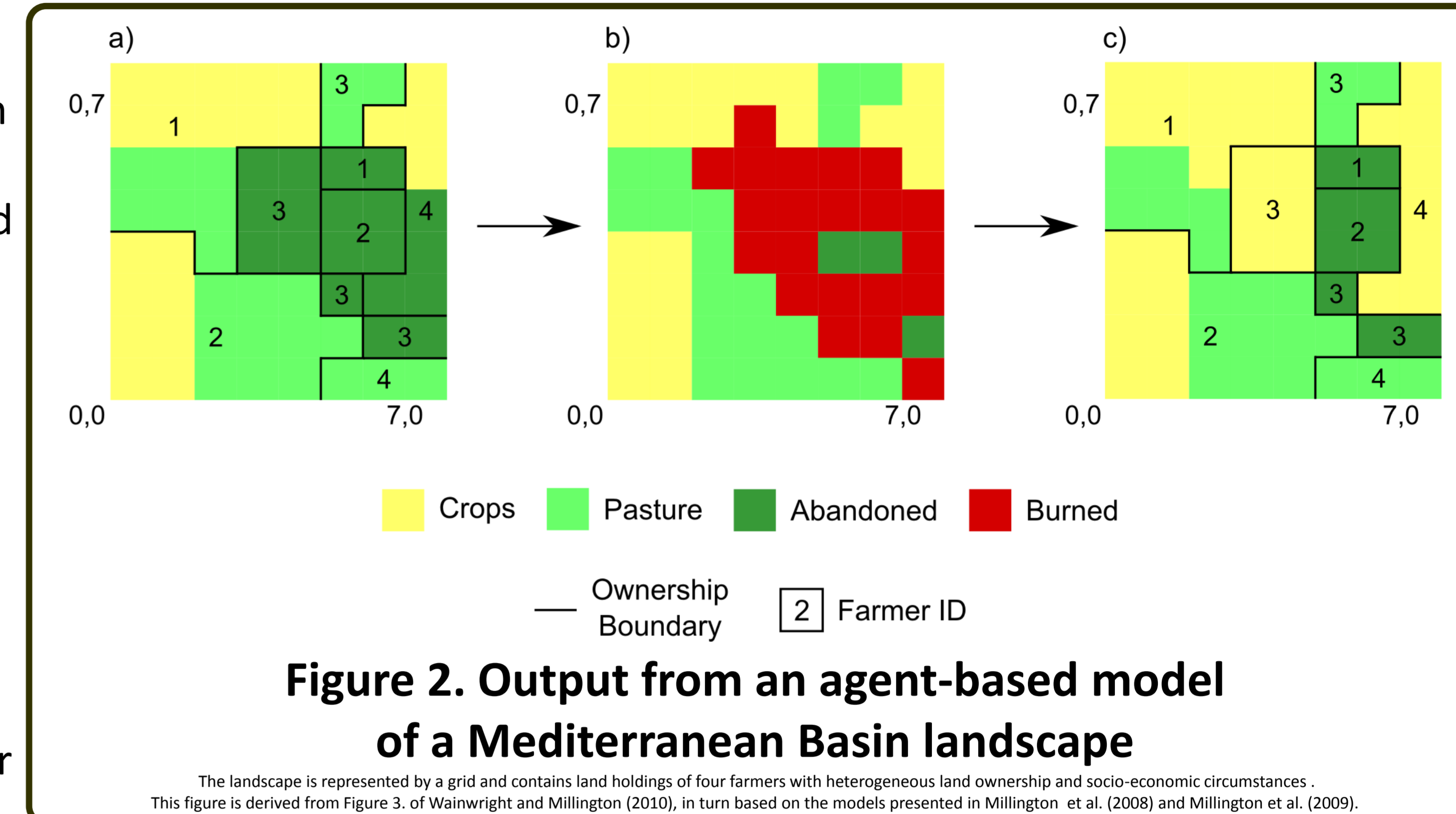
These **local** narratives can counter the abstract, vast, and systemic narratives that dominate current **global** environmental concerns such as climate change (e.g., Cronon 2006).

2) User reflection

Confronting stakeholders with explicit narratives derived from models representing their activity will help both modelled and modeller to identify important underlying, possibly implicit, assumptions about how their **individual actions** relate to broader environmental change.

The example in Box 1 demonstrates the **importance of context** for individual farmer land-use decision-making in landscapes typical of the Mediterranean Basin. (Fig. 2). The example **narrative highlights contingent events** resulting from model structure and previous conditions.

Several mini-narratives (e.g., Box 1) may be **embedded** within a broader narrative about the model and within another about the model building process (see below).



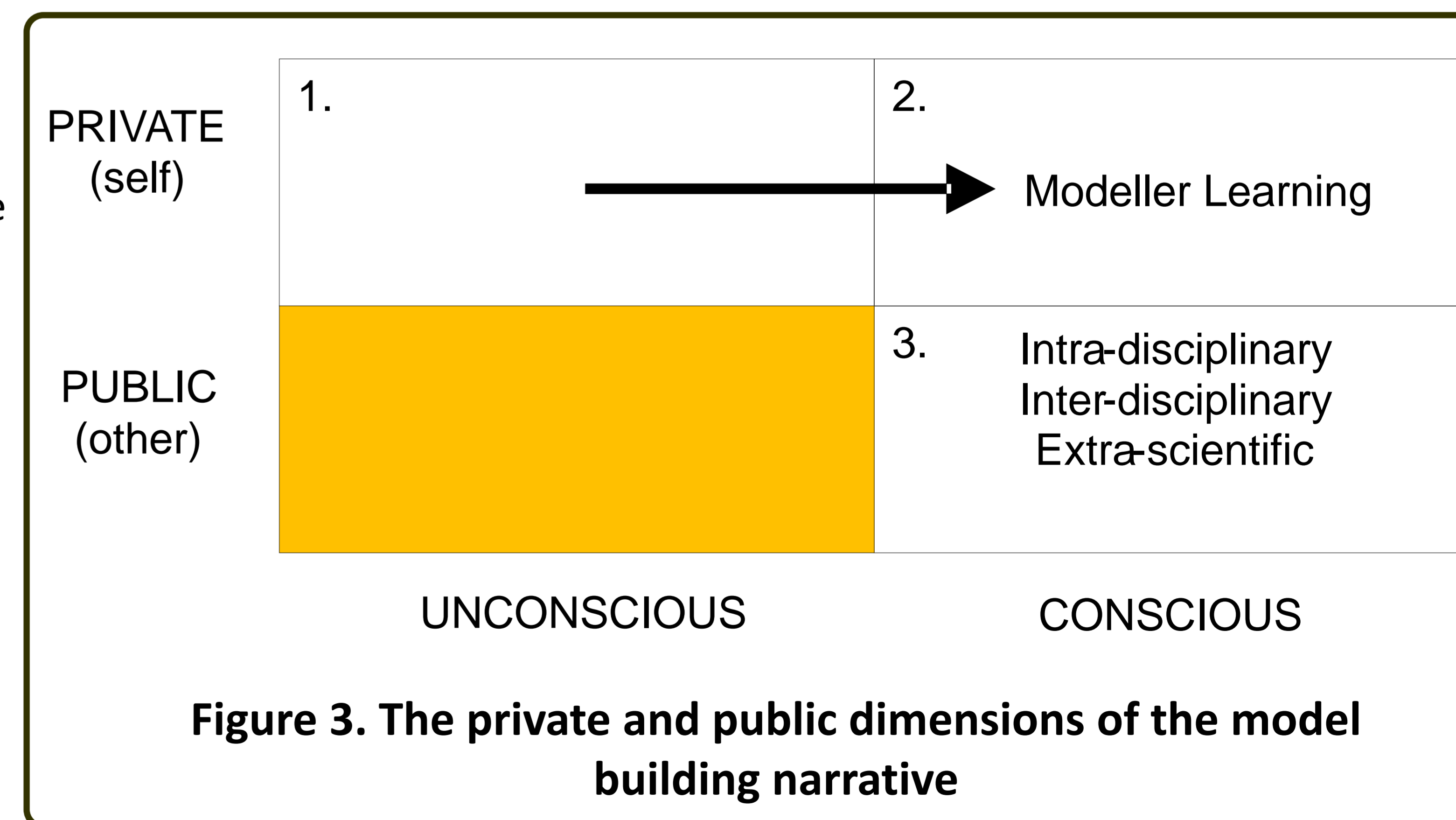
Box 1. Example Mini-Narrative from Model Output

"One year, a wildfire preferentially burned more densely vegetated pixels, notably those abandoned from agricultural use in previous years and which contained early successional vegetation (Fig 2b). Burning improved potential crop yields and following the fire land use change differed between farmers because of their different circumstances and the location of burned pixels. To increase income while minimizing costs due to spatial fragmentation, Farmer 3 converted six conterminous burned pixels (at coordinates 3,3 to 4,5; Fig. 2c) to crops, but not individual pixels (at coordinates 5,2 and 7,1). However, already with much land under cultivation (in conterminous pixels), Farmers 1 and 2 did not convert their pairs of burned pixels (at coordinates 5,5, 6,5 and 5,4, 6,4, respectively) as the added production did not outweigh the costs of their fragmentation from the remainder of the farm."

3) Model building process

All developers of generative simulation models develop some kind of **internal monologue** as they work. The implicit mental model and understanding of the modeller can be made explicit by general narratives of the modelling process.

By taking the internal (private) monologue of the modeller and presenting it as a narrative, greater **understanding and learning** about the model construction process will be attained.



Further, narratives provide a means to **communicate** this understanding to **non-modellers** (by moving from box 2 to box 3 in Fig. 3).