

## Cultural and Social Modelling

How can important social challenges be understood, predicted, and regulated through modelling? Recent social events have shown the effects of faster communication networks on rapid idea dissemination. How can we understand idea assimilation?

What is the impact of culture on belief systems and infectious ideas? Can an understanding of tools from genetics be applicable? We propose an approach to do so.



### Culture Modelling Needs Networks

To understand, predict, and assess cultural impact we focus on a two-systems approach to address the **Communication system** (social) and the **Interpretation system** (psycho-social). Previous work explored culture from a social network perspective.

Currently we are addressing the influence of the interpretation network:

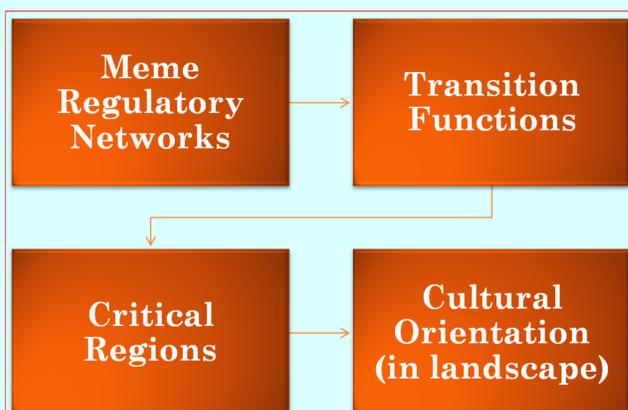
- A) How ideas integrate into existing belief systems
- B) Properties of receptive idea on belief structures for individuals, groups, or society-at-large



## Memetics-to-Culture Relationship

The persistence and spreading of cultural artefacts through time with variation is analogous to variation with heritability in that both are examples of what Darwin called "descent with modification". Biased (non-random) selection can be imposed on both types of processes and consequently both can undergo a form of evolution. The term **meme** is used here to describe single units of **cultural** transmission. According to Dawkins, a successful unit of natural selection will exhibit the following characteristics:

- **Longevity**—the ability to survive long enough to be replicated.
- **Fecundity**—the capacity to be replicated and the frequency of replication.
- **Copying Fidelity**—the ability to be transmitted so that the original and replicated forms are similar.



## Our Research

A **meme regulatory network** is introduced as a framework for discussing the integration of ideas into an individual's belief system based on self-organization and selective processes. We are interested in how idea integration influences the complexity and adaptability of mental constructs (meme networks).

## Cultural Modelling Approach:

Our proposal of a memetic regulation network, similar to the gene regulation network, provides an opportunity to apply standard techniques from genetics and dynamic systems theory to less standard and fuzzy ideas about culture. Memes and genes both exist within regulatory interpretation systems, which are useful for theorizing about, and experimenting with, the behavior of these systems.



## Memetics-to-Genetics Relationship

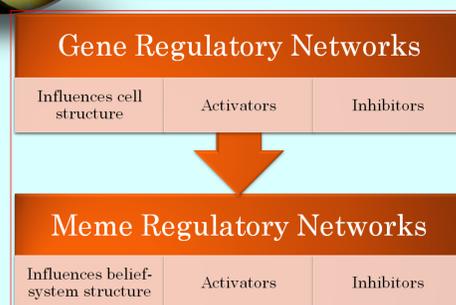
### Genetic Network

Genes exist within and are transmitted by complex carrier systems containing other genes and environmental artefacts. These artefacts include RNA and numerous structural, regulatory, and enzymatic proteins which combine to construct and regulate diverse molecular assemblies and sub-cellular compartments.

### Memetic Network

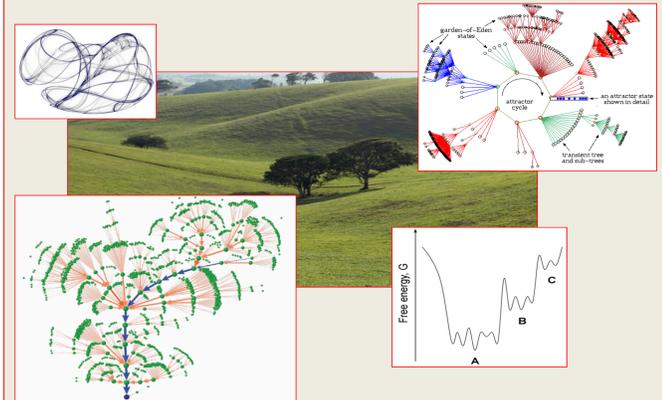
Memes are replicators of a certain kind that, like genes, are dependent upon a network for their transmission. For instance, just as the expression of gene products can regulate the future expression of other genes, ideas similarly participate in forming complex mental constructs that regulate the expression of future ideas and thoughts. Furthermore, robust expression patterns emerge in both systems through the self-organization of activating and suppressing interactions amongst genes/memes.

Here we begin to explore the possibility that a roughly analogous Memetic Regulation Network – a model for the dynamic construction of personal mental constructs – can provide a richer conceptual framework for understanding: (1) how ideas are accepted, modified, and integrated into a person's belief system, (2) how the requirements of meme survival within an individual's belief system influence the transmission and infectivity of ideas over longer periods of time across a social network and (3) how individual ideas can contribute to the evolution of complex cultures across a population.



## Attractor Landscapes

Attractor landscapes could be useful for conceptualizing the behavior of memes and their evolution, as well as the properties of memetic networks that influence resilience, fitness, and evolvability. Attractors are stable solutions of a dynamic system. Attractor basins define the sets of initial conditions, or states, that a system can take on yet still lead to a particular attractor, according to the system dynamics.



## Gene Expression Attractors

Gene regulation forms an attractor basin, whereby many genes are turned on and off over time to form an expression pattern. In GRN networks that are isolated from environmental stimuli, attractors are static, periodic, or quasi-periodic expression patterns that represent stable solutions for the dynamic system.

### Memetic Attractors

Within a meme or gene network, the integration of new memes/genes can both influence the timing and the general context (i.e. regulate) in which other memes/genes are invoked. This will have wider consequences to meme/gene expression patterns that can, in principle, be visualized by an attractor landscape.

More generally, attractor landscapes might be helpful in conceptualizing how the integration of new memes will influence expression within the wider meme network. In this context, individual points within the attractor landscape represent discrete thought patterns, and a basin of attraction represents the range of mental contexts in which a network of memes can be invoked and self-organize into a robust expression pattern of active ideas, i.e. the set of contexts that can lead to the construction of a particular thought pattern.

Importantly, properties typically associated with meme fitness might be translatable into statistically consistent changes in the global features of the memetic attractor landscape. For instance, for memes to survive transmission and become integrated into a meme network, the meme should have minimal contradiction with most other mental constructs. This implies that the attractors within the landscape will mostly be preserved, i.e. the belief systems of the individual remain unchanged. Second, to survive a meme cannot provide purely redundant information. For instance, a meme might change properties of the basin of attraction for one or more attractors in which the meme is invoked. A fit meme might widen the basin of attraction, thereby making the associated mental constructs relevant/activated in a greater number of contexts. Alternatively, a meme might change the connectivity between attractors, thereby altering the environment-dependent transitions from one thought process to another.

## From Genetics to Culture

It remains to be seen whether the meme-network paradigm proposed here will yield useful computational models for understanding the consequences of meme acceptance and integration. There are likely to be important differences between GRN models and memetic network models however the studies of GRN reviewed here provide interesting ideas for how such models can be analyzed.