**INTRODUCTION**

Existent models of information transmission demonstrate how structural factors, such as the structure of a social network, impacts the propagation of ideas. We take a somewhat different approach and argue that the spread of ideas through a social network is largely on psychological factors (e.g. the beliefs, attitudes and values shared by groups of individuals).

A particular focus of interest for us concerns what are known as ‘idea models’, which correspond to models of culturally-wrenched belief systems. One way of representing such models is by the use of a network of causally-linked concepts, where the nodes represent specific concepts and the links represent specific cause-and-effect relationships. The result is what we refer to as an ‘idea network’. The figure below illustrates the idea networks of two groups (upper ellipse) composed of individuals who interact via a social network (lower ellipse).

**Existing Models of Idea Spread**

We will now review a few of the literatures relevant to the study of idea spread. These areas provide some insight into how the characteristics and functions of ideas might influence their spread in a social system.

**Diffusion of Innovations**

Diffusion of innovation researchers, such as Everett Rogers (1995), have proposed conceptual models of idea spread that take into account decision-making, making, and the similarity of social actors. A popular computational model from Rogers’ work is the Bass Diffusion Model (Bass, 1969), which takes the following form:

\[
M(t) = \frac{M_0}{2} \left(1 + \sqrt{1 + 4 \frac{p}{M_0} t} \right)
\]

This model shows that the rate of adoption of an idea depends on the prevalence of the idea in the population, as well as factors such as the intrinsic value of the idea and the quality of its advertisement. Once these factors are specified, the function can be used to predict the number of people who will adopt the idea over a given period of time.

The Bass Diffusion Model provides some insight into the mechanisms of idea spread; however, it focuses primarily on the outcome of the idea propagation process (i.e. it predicts the number of people who adopt an idea) rather than the details of the actual process itself. This means that the model is not particularly well-suited to the development of computational models that attempt to simulate the process of idea propagation.

**Memetics**

Richard Dawkins coined the term ‘memetic’ to reflect the putative similarity between (different forms of) ideas and genes.

The main objective behind the concept of the meme was to identify a discrete unit that could be transmitted by an individual system-dependent upon the expression of the unit, which was then transmitted from one generation to the next. Dawkins underpinned the formation of the memetic model with the introduction of several genetically-inspired computational models of idea spread.

Perhaps the most influential memetic model is the one proposed by Cavalli-Sforza and Feldman (1981). This model describes both the inter- and intra-generational evolution of ideas, and incorporates several genetically-inspired factors. The fitness of an idea is defined in terms of a selection function, and the model also incorporates mutational mechanisms.

One of the primary contributions of memetics is the notion that the spread of an idea is largely determined by the characteristics of the idea itself. Lynch, (1985), for example, describes the process of idea spread as a process of multiple cultures with differing sets of ideas. Robert Axelrod is seen as the pioneer in this area. His multi-agent simulations (e.g., Axelrod, 1997) define simple interaction rules (see below) that promote idea consensus. However, when the parameters are set correctly, the simulations can give rise to distinct communities of agents, each possessing different sets of ideas.

**Cultural Transmission**

Recently, simulation-based models have emerged that demonstrate how simple interaction rules and feature-based representations can drive the development of multiple cultures with differing sets of ideas. Robert Axelrod is seen as the pioneer in this area. His multi-agent simulations (e.g., Axelrod, 1997) define simple interaction rules (see below) that promote idea consensus. However, when the parameters are set correctly, the simulations can give rise to distinct communities of agents, each possessing different sets of ideas.

Axielrod’s simulation protocol: 1. Select a unit at random and then choose one of its neighbors, again at random. 2. Determine the feature similarity of the units (i.e., this essentially the proportion of the features in the unit’s and its neighbors that are the same). 3. If the units interact, then select one of the features of the neighboring unit (at random) and assign it to the currently selected unit. 4. A limitation of Axelrod’s model is that beliefs are represented as sets of unrelated features. Research has shown that socially-shared beliefs are much more complex. Furthermore, Axelrod’s model does not consider random configurations. In reality, interacting agents do not form part of a centrally-controlled group, even though there is some variability between the agents in terms of their individual beliefs.

**Idea Networks**

Idea networks are one outcome of the idea propagation process, and are represented at the level of idea networks. The result is what we refer to as an ‘idea network’. The figure below illustrates the idea networks of two groups (upper ellipse) composed of individuals who interact via a social network (lower ellipse).

**Cultural Models in Simulation**

**RESULTS**

**DISCUSSION**

The results show how the initial idea network drives the transmission of ideas. Similar to Axelrod’s observation, agents that were initialized based on a slightly more diverse model were more likely to adopt other agents’ beliefs. This led to the development of more hybrid networks. However, two of the agents whose idea networks were spawned from cultural model 2 were not able to “break out of their initial belief set” and stayed true to their original idea network. The variability inherent in the cultural models certainly contributed to these within-culture differences.

Modeling the spread of ideas in the form of interacting cultural belief models is advantageous because it allows us to better characterize the actual process of idea propagation in social systems. Social network characteristics are important when modeling the spread of ideas; however, cognitive considerations are important in understanding the mechanisms underpinning idea propagation (see Simpkins et al, in press). Idea networks provide an interesting means of representing at least some of the cognitive factors that contribute to the dynamics of idea propagation in real-world social systems.