Ring Around the Kula: An Agent-Based Modeling Approach to Network Formation

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Introduction

In 1922, Bronislaw Malinowski published his seminal work, *Argonauts of the Western Pacific*. In this book, Malinowski documents a ceremonial exchange network between island communities throughout the area east of Papua New Guinea. This network, known as the Kula Ring, is now one of the most recognized, and possibly most well published, ceremonial exchange systems in the world. What has garnered the Kula Ring so much interest is the movement of two ceremonial gifts, *vaygu'a*, which travel in opposite directions. Necklaces, *soulava*, are traded through the system in a clockwise direction while armshells, *mwali*, move in a counter-clockwise direction. The exact details of the Kula Ring, including the number of participants, are a subject of debate among those who study it. This study uses a reduced model of the Kula Ring to explore the development of trade relationships in ceremonial exchange networks. These relationships are often considered mutually beneficial, but this model shows the variability in the importance of such relationships for each of the partners involved.

Exchange Networks

Ceremonial exchange networks differ from most modern examples of trade, which are examples of economic exchange. The decision to become involved in economic exchange is one of self-interest. Ceremonial exchange is a signal system for trustworthiness. Involvement in ceremonial exchange involves a belief that trade is obligatory and thus revolves around the concept of reciprocity (Ekeh 1974; Heath 1976). Central to the concept of reciprocity is the notion that accepting a gift places the recipient in a position of debt to the giver. To signal trustworthiness, a recipient must become the donor through the giving of an equivalent gift. In the Kula Ring, necklaces are reciprocated with armshells of the same quality and vice versa, however, the effort of one individual to return an equivalent gift may not match the effort it takes another individual to return such a gift. Thus, while the gifts being exchanged are mutual, the trading partners may not view their relationship in an equivalent manner. By using such vocabulary as mutual, reciprocal, and equivalent when describing ceremonial exchange networks, the variability in an individual's reliance on his different trading partners is overshadowed. Even in non-hierarchical tribal level societies such as the one examined here, hierarchical levels of trust between trading partners exist and influence trading patterns.

What is an agent-based model?

An agent-based model (ABM) is a computational model designed to explore the consequences of assumptions about behavior by simulating the interactions of agents, i.e. individual or collective entities (e.g. people, animals, organizations, communities, etc). This approach is gaining popularity in the social sciences as a way to test mathematical equations formulated to "describe a social process." ABM is also useful, as the case here shows, in exploring social processes for which formulating an equation may not be possible or useful. ABM allows researchers to test a variety of hypotheses regarding how agents interact and to test such assumptions with non-rational agents. ABM is especially useful for anthropologists, and archaeologists in particular, who are interested in understanding the long-term processes that are a part of cultural systems. The ABM used in this study was created in Netlogo 4.0.3.

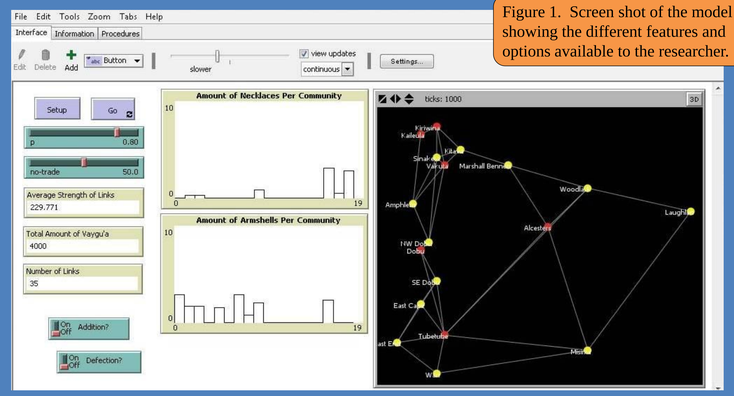


Figure 1. Screen shot of the model showing the different features and options available to the researcher.

Setup and Initialization of the Model

- The model is a replication of the starting mechanism of the Kula Ring, originally developed by Rolf Ziegler (2007, 2008).
- The 18 communities and 35 links are created during the setup of the model (Figure 1). Each community is an agent and is connected to other communities, referred to as neighbors.
- Communities begin without any armshells or necklaces and without any knowledge of having previously received an armshell or a necklace from any of its trading partners (i.e. neighbors).
- Armshells and necklaces only enter the system from the four producing communities: Kaileula and Woodlark produce armshells and Tubetube and Wari produce necklaces.
- The probability *p* controls whether or not these communities produce one *vaygu'a* per time step.
- All communities also produce a generic trade good, which is imagined to be the necessary assemblage of ceramic vessels for one household.
- The amount of this generic trade good produced is based upon the community's population size (i.e. during each time step communities produce one generic trade good for every six people).
- The community's population size also determines how much of this generic trade good the community needs from its neighbors. Each community visits one neighbor at a time until its threshold for the generic trade good has been met. Currently, the threshold is defined as the population size divided by three.
- The remaining processes of the model are depicted in the flow diagram (Figure 2). An in-depth description of this replication in the standard ODD protocol and the model itself can be found at www.openabm.org.

Figure 2. The flow diagram of the model processes and scheduling (A = armshell, N = necklace, B = *basi*).

How stable is the ceremonial exchange network?

- Even when communities had the opportunity to opt out of a trade event, there was stability in the strength of its trade relationships from run to run (Figure 3).
- This matches with anthropological observations that the primary role of ceremonial exchange networks is to maintain trade links that are not necessary at all times. The continual participation in a ceremonial exchange network helps maintain important trade links in periods of resource stability.

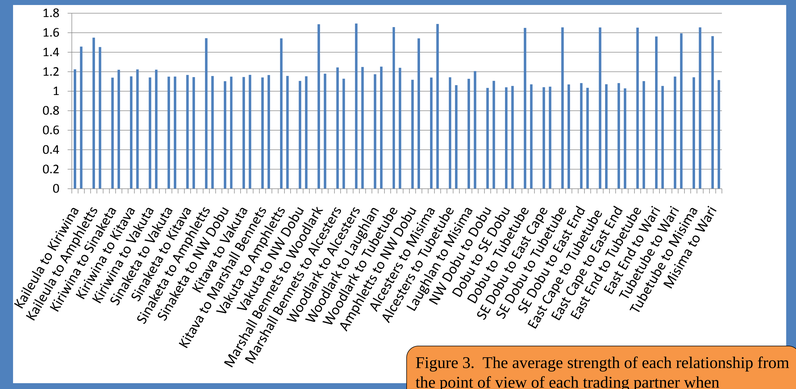


Figure 3. The average strength of each relationship from the point of view of each trading partner when communities do not have the option to opt out of trade.

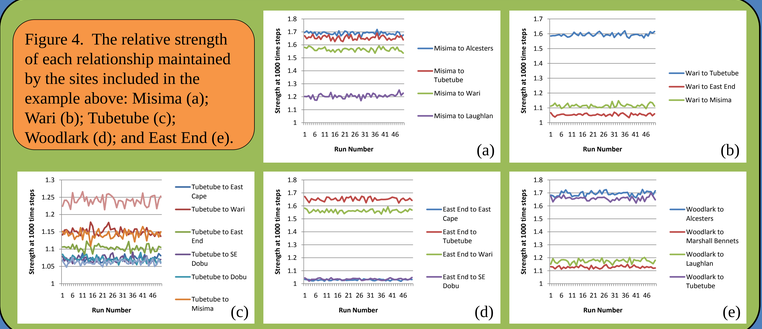
How is the strength of a relationship viewed by the communities involved?

Each community views its relationship with its neighbors in a different way than that neighbor views the same relationship. This is best illustrated with an example (Figure 4). When examining a series of interisland relationships without the chance that a community may randomly opt out of trade and without a community leaving or joining the network, the following observations are made:

- Misima views the relationship as stronger than Wari views the same relationship.
- Wari views its relationship with Tubetube as the strongest, however, Tubetube only views Wari as a moderately strong trading partner.
- Tubetube views Woodlark as its strongest trading partner and Woodlark also views Tubetube as one of its strongest relationships. This was expected as Tubetube and Woodlark both produce *vaygu'a* and should be able to reciprocate the proper gift more often than other communities.
- Wari views Tubetube and not East End as a strong trading partner ,while East End considers Wari to be a strong trading partner showing differential levels of reliance. Since Wari produces a type of *vaygu'a*, East End must rely on Wari more than Wari must rely on East End.

Future work incorporating different types of trade goods may help to thresh out even more details concerning the different levels of trust, reliance, and dependability in exchange networks such as the Kula Ring. This preliminary analysis does support our initial argument that despite being a non-hierarchical, tribal level society, the Trobriand Islanders may hierarchically rank their trade partners through the signaling system inherent in the Kula exchange.

Figure 4. The relative strength of each relationship maintained by the sites included in the example above: Misima (a); Wari (b); Tubetube (c); Woodlark (d); and East End (e).



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†See handout for references.