Coursework 2: Demography and Culture

Daniel Jenkyn

April 11, 2018

1 Introduction

According to Powell et al. the Upper Paleolithic (UP) transition shows evidence of rapid technological advancement (2009).

This paper will attempt to reproduce Powell et al.'s findings with the aim of exploring the benefits of a population that shares knowledge, through an increased tendency to form high-density sub-populations. If Powell et al. are correct, then the speed at which the agents learn should increase as they spend a greater amount of time socialising in their sub-populations; so long as there is an adequate amount of food for them to survive (2009).

The simulation used in this paper borrows heavily from a similar project from Bryson et al. (2007).

2 Approach

Agents are spawned in five small sub-populations of a hundred individuals. Each sub-population contains a spread of agents, each with distributed energy and age as per Bryson et al. (2007) original simulation.

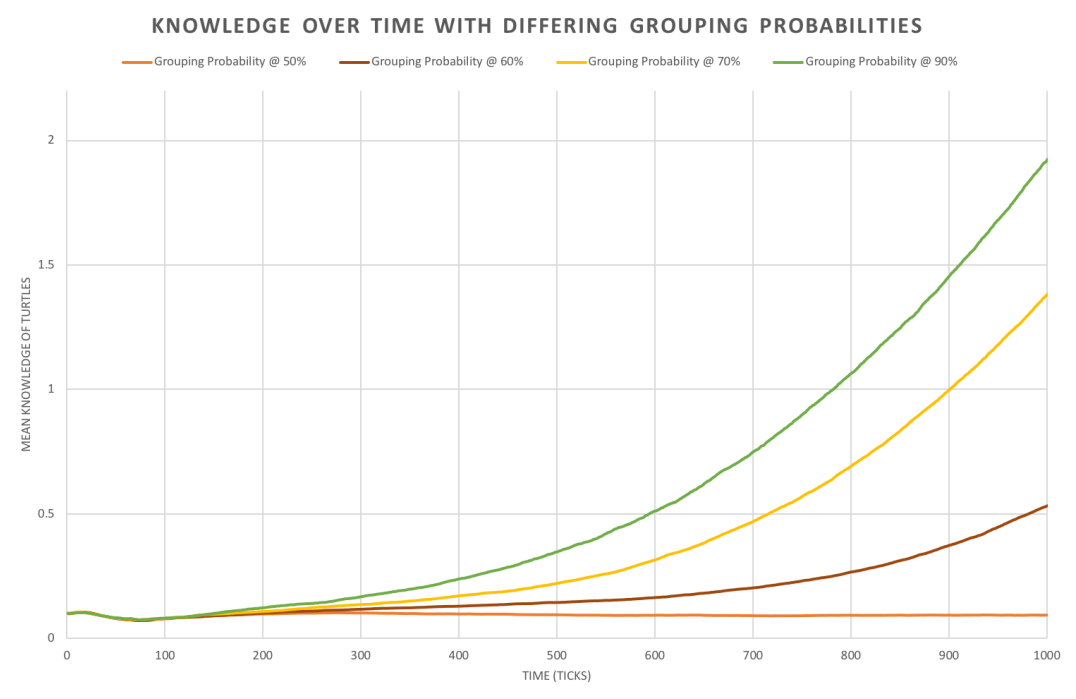
The agent's grouping behaviour is fairly simplistic with agents moving away from their sub-population if they are sufficiently hungry, or low on energy. The agents will then eat food until they recover their energy. At this point, they will return to the highest concentration of agents. The agents actually benefit from wandering into a more heavily populated area, at the risk of there being less food and starving. If any sub-population is to die, then all knowledge in that sub-population is lost.

Agents learn from the agent with the highest level of knowledge in range. To prevent an exponential increase in knowledge, an agent can only learn half of the teacher's individual knowledge. It should also be noted that offspring, at birth, will learn whatever they would individually discover in their lifetime with the base knowledge required to survive.

The independent variable in this experiment is the likeliness for an agent to move towards a sub-population; the grouping probability. The higher this probability, the more time an agent will spend in the sub-population, and therefore spend more time socialising; gaining knowledge.

3 Results

As shown in the results it does so appear that a higher proportion of the time an agent spends in the group, the greater propagation of knowledge leading to an increase in learning; so long as the grouping probability is above 50%. At 50% it appears that there are no effects on knowledge.



4 Discussion

A flaw with Powell et al.'s findings is that it assumes learning behaviours takes place instantly from the best agent in their population. However, as pointed out by Hawks, the model is deterministic, depending on how the skill is distributed; it will either trend upward or downward, thus never reaching an equilibrium between the two (2009).

5 Conclusion

The simulation managed to successfully reproduce the increased rate of learning as population density increased, demonstrated by Powell et al. (2009). Furthermore, the results show that it is beneficial for members to spend as much time as possible in high density sub-populations, resulting in an increase of knowledge.

References

Bryson, J. J., Ando, Y., and Lehmann, H. (2007). Agent-based modelling as scientific method: a case study analysing primate social behaviour. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 362(1485):1685–1699.

Hawks, J. (2009). Learning, population size, and "modern human behavior". `http://johnhawks.net/weblog/topics/information/learning/powell-2009-learning-transmission-demography-modern.html`. Accessed: 2018-03-24.

Powell, A., Shennan, S., and Thomas, M. G. (2009). Late pleistocene demography and the appearance of modern human behavior. *Science*, 324(5932):1298–1301.