Pre-reading 7 notes

1. Smith (2002) introduces the Iterated Learning Model. What is iterated learning?

Iterated learning happens when learners learn from the output of other learners. In my 2002 paper, this is modelled by having a population of agents; new agents enter the population periodically, and learn their signalling system from meaning-signal pairs produced by other agents selected from the population; since everybody learns in this way, once the initial (all-0-weight) population is replaced, every incoming agent is learning from individuals who were themselves learners, and so on.

2. In that paper, I laid out a hierarchy of weight-update rules. Which of the following is an accurate summary of that hierarchy?

- ( ) Not all weight-update rules allow an agent to learn an optimal signalling system. Of those that do, not all allow a population of agents to construct an optimal signalling system over iterated learning. Of those that do, not all allow a population of agents to maintain an optimal signalling system over iterated learning.
- (x) Not all weight-update rules allow an agent to learn an optimal signalling system. Of those that do, not all allow a population of agents to maintain an optimal signalling system over iterated learning. Of those that do, not all allow a population of agents to construct an optimal signalling system over iterated learning.
- ( ) Not all weight-update rules allow an agent to learn an optimal signalling system. But those that do also allow a population of agents to maintain and construct an optimal signalling system over iterated learning.
- ( ) Not all weight-update rules allow an agent to learn an optimal signalling system. Of those that do, not all allow a population of agents to maintain an optimal signalling system over iterated learning. However, no weight update rule allows a population of agents to construct an optimal signalling system over iterated learning - optimal systems must come from some other mechanism.
- ( ) All weight-update rules allow an agent to learn an optimal signalling system.

The idea is as follows:

- There are 81 weight-update rules
- Of those 81 rules, 31 cannot learn an optimal system, and 51 can.
- Of those 51, only 18 can maintain an optimal system over iterated learning (i.e. we initialise the Iterated Learning Model with an optimal signalling system and see if it is preserved, despite the fact that the population is gradually replaced).
- Of those 18, only 9 can construct an optimal system from scratch (i.e. we initialise the Iterated Learning Model with random signalling behaviour and see if an optimal communication system gradually develops as a result of the changes, or 'errors', new learners make).

3. In your own words, what property of a weight update rule determines whether it can maintain and/or construct an optimal signalling system?

What I said in the paper was that it all depends on the learner's bias with respect to homonymy.

Learners who are biased in favour of homonyms (i.e. many meanings mapping to a single signal) cannot maintain an optimal signalling system - they will make errors during learning which tend to introduce new ambiguous signals, and these errors gradually accumulate as more and more learners enter the population, eventually destroying the perfect system.

Learners who are neutral with respect to homonymy don't have this problem - they can maintain a perfect system, since they don't systematically introduce ambiguities that destroy it. But on the other hand, they can't construct an optimal system - they aren't biased against homonyms, so they tend to end up with signalling systems with some intermediate level of homonymy, since homonyms are neither added or eliminated.

Finally, learners who are biased against homonymy are great - they can maintain a perfect system, since it's the kind of system they expect to lean, but over iterated learning they can also construct an optimal system; every new learner entering the population tends to make 'mistakes' during learning which reduce the amount of homonymy in the population's signalling system, which eventually leads to a total loss of homonyms, i.e. an optimal signalling system.