Hammond and Axelrod's model is not useful for studying ethnocentrism

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Hammond and Axelrod's 'ethnocentrism' model was initially published as a model on the armpit effect and inclusive fitness among simple organisms (Axelrod, Hammond, and Grafen 2004). The same model was later reframed as a model on ethnocentrism among humans (Hammond and Axelrod 2006), and inspired a branch of research on group discrimination. The question, though, is whether such a reframing is warranted. I will argue that it is not, and thus that there is little we can learn about group discrimination from the model and that researchers in the field should abandon this approach.

Simple models on human behaviour can be useful as illustrations of ideas and their consequences. Schelling's model (Schelling 1971) shows by example how easily segregation emerges with even moderate preferences for homogeneity. The model is intuitive and we can understand the mechanisms, calling to attention that segregation may be a harder problem than previously considered. Similarly, the Axelrod model (Axelrod 1997) illustrates the not initially obvious but easily interpretable emergence of clusters from local homogenisation.

The Hammond and Axelrod model is related to both of these, in that it has the same spatial structure, but contrasting from these, it does not really deal with emergent phenomena at the aggregate, but rather provides a context in which agents become tag-based co-operators. While both preferences for heterogeneity and local homogenisation are compatible with segregation and clustering, co-operation in a one-shot prisoners' dilemma is inherently incompatible with increased fitness. The model thus needs to make additional assumptions in order for tag-based (or any) co-operation to evolve, making it less transparent. These additional assumptions are by necessity driving the results, and it is therefore crucial to analyse their respective effect on the outcome and real-world interpretation. In particular, do assumptions related to the armpit effect carry over in this case to explain discriminative co-operation between people?

The most important additional assumption is that agents reproduce (through cloning) onto the neighbouring patch, which is also the patch that the agent interacts with. This completely changes the game: successful agents are going to interact mostly with (perfect replicas of) themselves. The adaptive strategy is then of course to co-operate. Simulations also confirm this: without markers, universal co-operation is the dominant strategy. Already here, the model is unable to address why tag-based co-operation evolves, and can potentially only illustrate the evolution of tag-based defection (towards outgroups).

In fact, a large majority of the agents' neighbours are its clones, with the same marker and strategies (Jansson 2013). If a neighbour has a different marker, then the agent can be almost certain that the neighbour is not a clone, and defection evolves, as it would in a one-shot prisoners' dilemma. What the model shows us, then, is basically that if tags are reasonable

identifiers of clones, then agents will defect against those who are not identified as such. The applicability to what we know about ethnocentrism is practically nil.

A remaining potential application is that the model could tell us something about our evolutionary past, but that requires that the model can be generalised and the additional assumption relaxed. Can it then? Does it provide a starting point for the evolution of ethnocentrism?

It turns out, in simulations, that it cannot (Jansson 2013). The model is sensitive to assuming a lattice structure with few interacting neighbours, that you do interact mostly with clones, and that the copying process at cloning is not too erroneous. As soon as you depart from these, tag-based defection diminishes. At best, the model illustrates how kin identification could evolve among simple organisms that live adjacent to their identical offspring when there are only a few identifying traits available, for example among cells (Axelrod, Axelrod, and Pienta 2006). Since the, for humans inept, assumption of neighbouring clones is the mechanism behind the result, new attempts at explaining ethnocentrism (of which there are several – the 'ethnocentrism' paper has been cited by some 300 papers, many of these adopting similar frameworks and assumptions, and the model is part of the Netlogo library) need to do so without this assumption, and find a different mechanism.

To point out directions for future research, note that the structural effect of the additional assumption is to change the game from a one-shot prisoners' dilemma to a game with other utilities, and strategies that are not necessarily about co-operation and defection. A way to find out which underlying structures lead to tag-based co-operation is to strip away the spatial assumptions and analyse a minimal version of the model, but where the game can vary.

The result is that games of co-operation and defection (such as the prisoners' dilemma) do not generate tag-based discrimination, but that co-ordination and anti-co-ordination games do, at least in games where the optimal strategy entails a risk, such that not the whole population will converge to it (Jansson 2015). This result may point modellers in the direction of what kind of situation to aim for, when building models that do address issues of human group biases.

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