Investigating the relationship between social learning efficiency and the diffusion of innovations.

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Many animals rely heavily on social learning - learning facilitated by the observation of, or interaction with another individual or its products [1] - and theory predicts that this learning should be strategic in order to be adaptive [2]. For some species, including humans, social learning leads to the diffusion and maintenance of behaviours over many generations: the process of cultural transmission [3]. It is hypothesised that species differences in cultural complexity are driven by differences in evolved social learning mechanisms and the population dynamics of different cultural systems [4, 5]. The diffusion of innovations is an integral part of this cultural process and whilst it is understood that biases in social learning will impact the diffusion of innovation [6, 7], it is unclear how the diffusion of innovations is related to the efficacy of any particular social learning mechanism or strategy. Here we study innovation diffusion as an emergent process of adaptive social learning in an evolutionary context.

We present an agent based simulation model of a difficult learning task in a complex, variable environment. Agents adopt different social learning strategies and compete to learn and exploit the most adaptive behaviours [8]. As well as general decisions about when and how to learn, we examine the impact of success biased social learning, whereby individuals demonstrating long term success are copied preferentially [9]. Crucially we consider the adaptive benefits of the learning process and how the diffusion of innovations is influenced by optimal decision making in a social learning context.

In the absence of a success bias we find that strategies that yield high innovation diffusion rates out-compete those with low diffusion rates. When biased social learning is in operation we show a considerable increase in the rate of diffusion and maximum spread of innovations as well as a consistent improvement in competitive ability of biased strategies over strategies copying others at random.

We conclude that differences in social learning mechanisms will greatly impact the diffusion of innovations and that in many circumstances mechanisms that promote rapid diffusion will be more adaptive. As a consequence we hypothesise that high diffusion rates may be a hallmark of social learning efficiency. These results are particularly relevant in understanding cultural evolution and behavioural diversity across taxa.

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