

Reply to Xue & Costopoulos, “The Evitable Route to Zealotry - on Ghirlanda et al. 2006”

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In Ghirlanda et al. (2006) we presented a paradox. We argued that, if culture can influence people's openness to new information, then cultural evolution is likely to foster conservative individuals who are reluctant to acquire new culture. We also argued that cultural evolution would promote people's ability to persuade others. We demonstrated these predictions in a simple model in which cultural evolution created conservative and persuasive individuals. We noted, however, that the model's predictions were too extreme: people become neither completely conservative nor perfectly persuasive. We concluded that understanding the cultural dynamics of conservatism and persuasiveness requires new theoretical advances. Xue & Costopoulos (X&C) have taken up this challenge, studying potential determinants of openness and persuasiveness as well as the impact of openness and persuasiveness on cultural diversity.

X&C first show that allowing errors in cultural transmission, allowing individuals to change only little when imitating others, and embedding individuals in a spatial structure result in final openness and persuasiveness values that lie within about 0.1 from our model's, corresponding to approximately a 10% increase in the probability of cultural transmission. Next, X&C introduce a new model in which individuals possess a cultural “attribute” whose transmission is influenced by openness and persuasiveness (see X&C for details). They report that, when individuals change little in each social interaction, persuasiveness does not rise to high values, and a diversity of attribute values can be maintained. Stimulated by these intriguing results, we simulated both our original model and several variations of X&C's model varying the amount of change allowed in a social interaction (see Figure 1).

We realized that even our model does not always predict high persuasiveness. In fact, for a cultural type to replicate many times, low openness is much more important than high persuasiveness. Consider a cultural type with openness and persuasiveness values of p and q , respectively, in a population with average values P and Q . An individual keeps the cultural type (p,q) until she adopts someone else's p and q values, which in our model occurs, on average, after $1/(pQ)$ social interactions. During this time, the individual is copied an expected $Pq/(pQ)$ times by others. Thus increasing q has a linear effect on

the expected replication of a cultural type (“cultural fitness”), while decreasing p has a much stronger, hyperbolic effect. This causes openness to decrease faster than persuasiveness increases, slowing down cultural evolution and inhibiting the rise in persuasiveness. Thus X&C's study shows that the dynamics of Ghirlanda et al.'s (2006) model is richer than anticipated, confirming at the same time that conservatism is strongly favored in cultural evolution. Indeed, complete conservatism does not arise in simulations (or in real life) only to the extent that completely conservative individuals ($p=0$ and $q>0$) never appear.

We replicated X&C's study of cultural diversity in our original model and in several variations of X&C's model, varying the amount of change that individuals can undergo in a social interaction (Figure 1). Only in two cases diversity in cultural attributes is preserved. The first is X&C's model, in which both openness and persuasiveness are reset to random values when individuals copy a model with a different attribute. The second is a variation of X&C's model in which openness *only* is reset on such occasions. Resetting persuasiveness only, resetting neither openness nor persuasiveness, and simply adding a cultural attribute to Ghirlanda et al.'s (2006) model do not preserve cultural diversity. Resetting openness is crucial because, on average, it decreases the openness of individuals (individuals who undergo resetting are those who copy, i.e., those with high openness). This produces, as X&C note, “isolationist” individuals who are even more conservative than in our original model (Figure 1, center). Thus diversity is maintained because cultural dynamics becomes very slow (indeed, diversity is not maintained if individuals change a lot in social interactions).

X&C's social learning rule construes adoption of new traits as “traumatic” events capable of resetting individual personality. Our intuition is that this may be more appropriate for major events such as religious conversions, than for everyday changes such as adopting someone else's clothing or food preferences. Thus X&C's study shows simultaneously the need for more empirical work on the psychology of social learning and for more theoretical work on the consequences of such psychological mechanisms for cultural evolution. We are currently investigating how openness can be maintained in cultural evolution, and what happens to cultural diversity in an open population. A forthcoming paper show that openness can be preserved given that only individuals who remain open can acquire the cultural traits that are necessary to become persuasive models (Acerbi et al., in press), and preliminary results suggest that under such circumstances populations can be culturally diverse.

Acknowledgments

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References

Acerbi, A., Enquist, M., Ghirlanda, S. *Cultural evolution and individual development of openness and conservatism. Proceedings of the National Academy of Sciences of the USA*, in press.

Legend to Figure 1. Evolved openness, persuasiveness and cultural diversity in Ghirlanda et al.'s (2006) model, and in several variations of Xue & Costopoulos' model (X&C), as a function of the amount of change allowed in a social interaction (corresponding to 1 minus the “memory” parameter in X&C). All maintain the distinction between “imitation” and “adoption” events (see X&C's text), but differ in how openness and persuasiveness change in adoptions (see text). We simulated populations of 100 individuals interacting for 5000 time steps.