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Preference Evolution, Two-Speed Dynamics, and Rapid Social Change

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We present a dynamic analysis of the evolution of preferences in a strategic environment. In our model, each player's behavior depends on both the game's payoffs and his idiosyncratic biases, but only the game's payoffs determine his evolutionary success. Dynamics run at two speeds at once; while natural selection slowly reshapes the distribution of preferences, players quickly learn to behave as their preferences dictate. We establish the existence and uniqueness of the paired trajectories of society's preferences and behavior. While aggregate behavior adjusts smoothly in equilibration games, in coordination games aggregate behavior can jump discretely in an instant of evolutionary time. *Journal of Economic Literature* Classification Numbers: C72, C73.

Key Words: evolutionary game theory; evolution of preferences; coordination games.

1. INTRODUCTION

The origins of evolutionary game theory lie in biological models of natural selection. The players in these models are animals genetically programmed to play a certain strategy; evolution is driven by differences in their reproductive success. Economists have adapted models from evolutionary game theory to study the dynamics of human behavior. As the behavior of economic agents is driven by conscious choice rather than

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natural selection, the economic models describe how agents *learn* to satisfy their preferences.

While economists usually study the behavior of populations whose preferences are fixed, it is worthwhile to try to explain where these preferences come from. Unlike their behavior, the preferences of economic agents are traits determined by natural selection. Preferences which lead to reproductive success thrive at the expense of the others. Of course, the effects of preferences on reproductive fitness are mediated through behavior; preferences determine an agent's actions, which in turn determine his fitness. Because preferences generate fitness in this indirect way, to understand preference evolution, one must act as both a biologist and an economist at once. While showing how the distribution of preferences is shaped by natural selection, one must also describe how agents learn to behave as their preferences dictate.

Although learning and natural selection occur simultaneously, the former proceeds much more quickly than the latter. Players can quickly switch to preferred strategies, but changes in the distribution of preferences are driven by gradual turnover in the population's membership. Preference evolution therefore leads us to consider dynamics which run at two speeds at once. We shall see that these dynamics require special techniques of analysis, and that they define a model of preference evolution with features not present in models of learning or natural selection alone.

In this paper we study the evolution of preferences in a strategic setting. In our model, a single population of players repeatedly plays a two-strategy game, the payoffs of which represent evolutionary fitnesses. Each player's utility function combines the common fitness function with his idiosyncratic biases. While preferences determine individual behavior, society's aggregate behavior determines which actions are fit, and hence which preferences survive. As the preference distribution is shaped by natural selection, behavior adjusts in tandem, as players alter their strategy choices to maintain equilibrium play.

We establish the existence and uniqueness of the solution trajectories of this evolutionary process. We find that in equilibration games (e.g., the Hawk–Dove game), aggregate behavior adjusts continuously in response to changes in the distribution of preferences. In contrast, strategy adjustment in coordination games may be discontinuous; discrete changes in the overall strategy distribution can occur in an instant of evolutionary time. Thus, when society must learn to distribute itself between strategies, the adjustment process is smooth; when society must agree on a convention, consensus may emerge in leaps and bounds.

We study the evolution of biases, by which we mean idiosyncratic preferences for certain modes of behavior. In our model, biases are simply predispositions toward or against each strategy; a player's overall payoff