Decision making in complex social environments: adaptivity and neurobiological mechanisms

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The nature and level of advice taking in human societies is unmatched in the animal world. The accumulation of knowledge through social learning is uniquely human and fundamentally important for the evolution of human culture (Boyd & Richerson, 1985). Researchers in Psychology, Economics, and Anthropology have investigated social learning, which often strongly influences people's decisions. Boyd and Richerson (1985) used mathematical tools from theoretical biology to show under which circumstances the capacity for social learning can evolve and to show how adaptive different rules of thumb for social learning (like "imitate a random other person" or "imitate a successful person") are under different informational constraints. Recent empirical work confirms the idea that people adaptively choose social learning rules when the environment changes.

Importantly, the social learning rules investigated by Richerson et al. assume that others can be observed before each decision and that decisions are made based on either individual or social learning. We developed a paradigm to investigate how people combine individual learning with advice. Specifically, participants learn in an instrumental learning task after they received advice about which is the best option. In a first combined behavioral and modeling study we showed a sustained influence of advice on learning, which was best explained by a reinforcement learning model that implements an outcome-bonus for outcomes from recommended choices (Biele, Rieskamp & Gonzalez, 2009 Cog Science). Building on this result, we have recently begun to investigate the neurobiological basis of following advice. FMRI results revealed a greater change in BOLD signal in the gain-sensitive septal area after recommended than after non-recommended choices. Surprisingly, but consistent with the outcome-bonus, even negative outcomes elicited a positive reward response when following advice. Moreover, individuals' outcome-bonus parameters predicted amygdala activity after gains. A fundamental question is whether the outcome bonus model is adaptive. Preliminary simulation results show that the outcome bonus model is more adaptive than a model that uses advice only as quickly decaying prior information. Simulations were limited, however, in that we a) only tested a reduced set of learning environments and b) generally assumed that the outcome-bonus is stable over time. Here, we propose to investigate the adaptive value of more complex social learning and decision-making mechanisms (that adjust the outcome bonus over time) and their neurobiological implementation in an interdisciplinary cooperation between theoretical neurobiologists (contributing simulations) and cognitive neuroscientists (contributing behavioral modeling and fMRI).