Individual Differences in Second Language Age of Acquisition and Language Entropy Predict Non-Verbal Reinforcement Learning Among Bilingual Adults

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Abstract

We investigated whether bilingualism affects non-verbal model-free vs. model-based reinforcement learning (RL). This dual-systems theory posits independent valuation systems in controlling choices and may overlap with systems of bilingual executive control. Forty-five bilingual adults completed a two-stage decision making task with transition and probability of reward dynamically varying. First, we calculated a model-based index to measure how much participants integrate environmental structure with reward when planning choices. Consistent with monolingual results, we found that bilinguals display model-free and model-based RL to differing degrees. Next, we assessed whether individual differences in second language (L2) age of acquisition (AoA) and language entropy interact with these RL systems. Bilinguals with earlier L2 AoA and greater language entropy demonstrated model-free RL, whereas bilinguals with later L2 AoA and lower language entropy demonstrated greater sensitivity to model-based reward frequencies. This suggests an interesting link between bilingual experience and how reward shapes decision-making strategies.