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PREDICTION ERROR SIGNAL CORRELATES WITH FLUID INTELLIGENCEAND DOPAMINE SYNTHESIS ACROSS THE LIFESPAN

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Introduction: Fluid intelligence expresses the capacity for interpretation of novel stimuli and flexible behavioral adaptation to such cues. Phasic dopamine firing closely matches a temporal difference prediction error (PE) signal important for learning and rapid behavioral adaptation. Both fluid intelligence and dopaminergic neurotransmission decline with age. So far, no study investigated the relationship between fluid IQ, PE signal and direct measures of dopaminergic neurotransmission. Here we used a multimodal imaging approach that combines positron emission tomography and functional magnetic resonance imaging.

Methods: A group of healthy controls was investigated with both 6-[18F]FluoroDOPA PET and functional MRI with a probabilistic reversal task. The task required a constant behavioral adaptation to changes in reward contingencies, while choosing between two abstract stimuli. A reinforcement learning algorithm was used to compute a trial-by-trial prediction error, which was the used as a regressor in the fMRI data analysis with SPM8.

Results: The prediction error signal was associated with functional activation in the basal ganglia including the ventral striatum and putamen. Fluid intelligence was associated with the PE signal in the ventral striatum, which correlated with age-related changes in dopamine synthesis capacity in the prefrontal cortex.

Conclusion: These findings provide insight into the role of age-related changes in dopaminergic neurotransmission on behavioral adaptation. The multimodal imaging approach allows the characterization of interactions between dopamine metabolism and learning-related neuronal activation and may thus be a useful tool to clarify mechanisms underlying learning and plasticity in old age, which are crucial to our understanding of successful aging.

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