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A Systems Simulation Model of Long-Term Memory Distortion in Bilingual and Cultural Contexts

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ABSTRACT

The Foreign Language Effect (FLE) has been associated with reduced emotional resonance and fewer distortions during recall, but research has largely focused on short-term memory and narrow language contexts. Distortions in long-term memory arise instead from dynamic interactions among linguistic processing, misinformation, social environments, cultural frameworks, physiological states, and developmental stage. This study introduces a large-scale system dynamics model, supported by meta-analytic evidence, to examine how bilingualism and language switching shape long-term distortion over periods ranging from a single day to sixty years. The model incorporates stocks for memory content, distortion accumulation, schema stability, emotional arousal, physiological resilience, and layered social influence, with flows representing encoding, misinformation uptake, correction, and schema updating. Subsystems capture linguistic structure and switching, schema-guided processing, cognitive biases, physiology, cultural authority, and age of acquisition. Simulations indicate that while FLE initially reduces emotionally driven distortion, its effect diminishes over decades as misinformation exposure, cultural narratives, and physiological capacity exert stronger influence. Counterintuitively, frequent switching between structurally distant languages reduced distortion more than monolingual recall, and adolescent memories emerged as more vulnerable to distortion than childhood ones. The framework challenges prevailing assumptions about memory fragility and highlights potential pathways for intervention through bilingual education, culturally responsive media literacy, and forensic practice.

Keywords: bilingualism; long-term memory; misinformation; social influence; system dynamics