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Reciprocal Links Between Math Self-Concept and Achievement: Evidence From Population-Level Administrative Data

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Population-level linked administrative data offer unique leverage for studying developmental processes that combine strong ecological validity with policy relevance. Using an administrative dataset linking educational records across childhood and adolescence for students in Ontario, Canada ($N \approx 112,000$), we investigated the reciprocal relations between math self-concept and achievement from Grades 3 through 9. We initially constructed a longitudinally invariant latent measure of math self-concept from survey items accompanying the provincial assessments, demonstrating the feasibility of deriving measures of psychologically meaningful constructs from these large-scale administrative sources. We then estimated random-intercept cross-lagged panel models (RI-CLPMs) separately for students who later entered Grade 9 math in either an academic or applied stream. Across both streams, stable between-student differences in self-concept and achievement were strongly associated, but their within-student dynamics exhibited distinct

developmental patterns. In the academic stream, achievement consistently predicted later increases in self-concept, whereas the effect of self-concept on subsequent achievement shifted from negative in early grades to positive by adolescence. Over the same period, the residual correlations between self-concept and achievement—reflecting the concurrent, within-student association at each assessment point—also strengthened. In contrast, the applied stream exhibited weaker and later-emerging within-person coupling, suggesting that students who eventually enter different Grade 9 streams already display distinct developmental dynamics prior to the formal curricular split. Our findings illuminate developmental mechanisms that are challenging to capture in conventional cohort studies. By separating stable differences from dynamic processes, RI-CLPMs clarify when, and for whom, self-beliefs may serve as a lever for supporting academic development.

