

BiSyntax Builder: Enhancing Bilingual Syntactic Awareness and Reading Comprehension Using a Hybrid Factorial-SMART Design

Children's ability to understand written texts sets the foundation for learning at school and success at work. However, reading comprehension worldwide is declining, and educators are struggling to effectively support students' mastery of reading comprehension, a task even more complex in a Hong Kong bilingual environment, where children must learn two structurally distinct languages, Chinese (L1) and English (L2). Approximately 13% of Hong Kong Chinese-English bilingual children experience reading comprehension difficulties in both languages, most often related to weaknesses in syntactic or morphosyntactic awareness. Our recently published studies suggest that syntactic structure binds lexical and sentence information, then contributes to reading comprehension through two pathways: syntax-to-lexicon and syntax-to-sentence. This project extends our previous investigations by developing the BiSyntax (Bilingual Intervention on Syntax) programs to strengthen these pathways in bilingual children. Employing an adaptive 4-arm randomized controlled trial (RCT) with a 2×2 factorial design and a 2-stage sequential multiple assignment randomized trial (SMART) design, we will: (1) develop L1 Chinese and L2 English syntax interventions and evaluate their effectiveness on improving syntactic awareness and reading comprehension in each language; (2) identify optimal pathways (i.e., syntax-to-lexicon, syntax-to-sentence, or combined) for improving bilingual children's syntactic awareness and reading comprehension; (3) test whether increasing the intensity of one pathway or adding additional booth activities benefits participants who show no improvement from initial training; and (4) assess the crossover effects of Chinese syntactic training to English syntactic awareness and reading comprehension, and vice versa. We will recruit 378 Chinese-English bilingual children (ages 10–11) from eight primary schools. Participants will be randomized into one of three embedded two-stage adaptive interventions, which differ in their pathway sequence: starting with syntax-to-lexicon, starting with syntax-to-sentence, following a combined pathway, or a control group. All children will complete pretest, training, posttest 1, and posttest 2. During the pretest and posttest, participants will complete behavioral assessments of Chinese and English syntactic awareness and reading comprehension, and measures of control variables. By integrating factorial and adaptive methodologies, this project will advance precision education in both theory and practice. Theoretically, it will disentangle syntax-to-lexicon versus syntax-to-sentence pathways; test whether their effects are additive, synergistic, or redundant; and quantify cross-language transfer. Practically, our project will replace static group assignments and one-size-fits-all methods with individualized instruction that dynamically adapts to students' ongoing responsiveness, and promote continuously refined strategies to improve both teaching effectiveness and academic outcomes.