Language in Late Adulthood as a Dynamic System:
Evidence from Naturalistic Mandarin "Old-Old" Conversations

Under the framework of Complex Dynamic Systems Theory (CDST), language is conceptualized not as a static repository of rules, but as a dynamic system of interacting lexical, syntactic, and affective subsystems (Spoelman & Verspoor, 2010). As individuals enter the "old-old" stage (aged 75–85), this system undergoes reorganization in response to the non-linear decline of fluid cognitive resources, such as processing speed and working memory (Park & Reuter-Lorenz, 2009; Wang & Wang, 2024). Moving beyond traditional structural metrics, this study adopts a multidimensional computational approach to investigate how age and gender dynamically shape the linguistic configuration of healthy Mandarin-speaking seniors using digital biomarkers extracted via Linguistic Inquiry and Word Count (LIWC).

Despite growing interest in gerontolinguistics, critical gaps persist. First, existing literature relies heavily on constrained laboratory tasks (e.g., the "Cookie Theft" description; Goodglass & Kaplan, 1983; Luz et al., 2021). These tasks often lack ecological validity, potentially exaggerating cognitive decline by isolating language from its social context (Horton et al., 2010; Ramscar et al., 2014). Second, traditional research frequently treats the elderly as a homogeneous group, overlooking the heterogeneity and non-linear trajectories unique to the 75–85 cohort (Margrett et al., 2016; Wang & Wang, 2024). Third, there is a scarcity of data on naturalistic "old-old" peer interactions in Mandarin Chinese (Huang & Yang, 2022). This study addresses these issues by analyzing a high-validity corpus of spontaneous conversations.

Guided by CDST, language change in late adulthood is viewed as a process of resource competition. As cognitive resources diminish, the language system settles into new "attractor states" to maintain communicative efficiency (Spoelman & Verspoor, 2010). We analyzed spontaneous narratives from 202 healthy Mandarin speakers (aged 75–85). Using LIWC 2015, we tracked the frequency of cognitive process words (e.g., insight and causation), pronouns, and affective words (Pennebaker & Stone, 2003; Sigona et al., 2025).

The findings reveal significant gender-specific adaptation patterns. Women exhibited higher linguistic stability and stronger social connectivity, evidenced by a robust reliance on first-person plural pronouns (we) and social reference words (Moscoso del Prado Martín, 2017; Pennebaker & Stone, 2003). In contrast, men demonstrated a shift toward "empty speech," characterized by a higher pronoun-to-noun ratio and a non-linear decline in cognitive process words approaching age 85 (Bucks et al., 2000; Sigona et al., 2025). Furthermore, a "positivity effect" was observed across genders, with increased positive emotion words serving as a compensatory strategy for functional losses (Dennis & Hess, 2016). Notably, the decline in speech rate was significantly attenuated in our naturalistic data compared to lab-based measures, suggesting that authentic social contexts provide a buffer against cognitive decline (Horton et al., 2010). These findings support the view of the aging brain as a dynamic system and offer implications for gender-sensitive clinical screening in Chinese-speaking communities.

Keywords: Complex Dynamic Systems Theory; LIWC; Naturalistic Conversation; Gender Differences; Mandarin Chinese.

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