Individual Differences of Spillover in Naturalistic Reading

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Background: Spillover effect happens when the processing difficulty of one word affects reading times on the following, but its causes and stability across individuals are still unknown. Classic reading models, such as E-Z Reader and SWIFT, link spillover to oculomotor planning or parallel processing, assuming it remains stable across individuals. Sentence processing models, e.g., surprisal theory, often treat it as a nuisance. Some recent studies suggest that spillover may reflect deeper cognitive processes, but it is still unclear whether it reflects a stable reader trait, a temporary state, or an interaction of both. This project investigates the stability of individual spillover effects across reading contexts, examines their modulation by cognitive abilities, and tests whether they are associated with overall reading patterns.
Method: We used six eye-tracking datasets that allow us to compare each participant's spillover effects across different reading contexts. In InDiCo (German) (Haller, 2026), participants read in two sessions, with a two-week interval between them. In PoTeC (German) (Jakobi, 2025), participants read both within and outside their expertise domain. In OneStop (English) (Berzak, 2025), participants did both normal naturalistic reading and repeated reading. In GECO-NL (Cop, 2017) and GECO-ZH (Sui, 2023), Dutch and Chinese participants read in both their native language (L1) and English (L2). In HKC (Chinese) (Wu and Kit, 2023), participants read both single isolated sentences and full paragraphs. For each participant, we estimated spillover effects of word length, lexical frequency, surprisal, and their stability using a Bayesian two-task hierarchical model (Rouder and Haaf, 2019). We then tested how these spillover effects are modulated by cognitive abilities and related to skipping and regression reading patterns.
Results & Discussion: Spillover effects showed different levels of stability across reading contexts. Word length spillover was the most stable, while frequency and surprisal spillover were less consistent. People showed different spillover patterns depending on the reading contexts—they did not adopt the same strategy across situations. Spillover effects were more stable across sessions, domains, and when the L1 and L2 were similar (e.g., Dutch–English), but less stable across distant languages (e.g., Chinese–English), reading regimes, and context lengths. Spillover effects are not uniform across readers and are modulated by reading fluency. Low-fluency readers showed resource-driven spillover, with stronger effects of low-level difficulty such as word length and frequency. In contrast, high-fluency readers showed integrative spillover, driven mainly by surprisal. These individual differences were systematically related to the overall reading patterns: greater sensitivity to previous word length and frequency was associated with less skipping and more regressions, while greater sensitivity to previous word surprisal was associated with more skipping and fewer regressions. These results highlight the importance of individual difference approaches for understanding spillover and challenge population-level analyses that obscure meaningful heterogeneity in reading.

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