What phonological copying reveals about working memory: the puzzle of reduplication and reversal asymmetry

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Introduction. Phonological working memory (PWM) is classically modeled as a phonological loop with a store and an articulatory rehearsal process [1]. Two measures probe PWM: digit span, targeting the limit of serial-order phonological short-term memory, and continuous nonword recognition (NWR), targeting the encoding and retention of novel phonological forms. Whether their contributions vary across phonological operations remains underexplored. Phonological copying provides a tractable test case. Wang & Hunter [2] decompose copying, underlying reduplicative morphology (e.g., Indonesian *buku-buku* 'books'), into a phonological *buffer* encoding and maintaining the base, and a *matching* operation comparing buffer contents to incoming material. The logically plausible yet typologically rare reversal counterpart (e.g., *buku-kubu*) admits no analogous decomposition. Moreton et al. [3] showed adults readily learn reduplication but fail at reversal, proposing PWM as a candidate mechanism without measuring individual capacity. **We hypothesize** (i) within reduplication, the two measures differentially predict learning rate, with NWR showing effects at short bases and digit span at longer bases; (ii) reversal shows no analogous PWM-modulated effects on learning rate.

Method. Native English speakers (N = 401) completed two tasks tapping into the two PWM measures, then a 50-trial auditory rule-induction task (25 targets, 25 scrambled foils) with binary judgments and trial-by-trial feedback, in a between-subjects 2×2 design crossing pattern (Red, Rev) and base length (3σ, 5σ); see Table 1. The 3σ stimuli replicated Moreton et al. [3]; 5σ tested length-dependent predictions. NWR and digit span were only weakly correlated (r = 0.15). After response-bias exclusions, N = 397. Trial-level accuracy was modeled in *brms* via Bayesian mixed-effects logistic regression with Trial × PWM interactions, by-subject and by-item random effects.

Findings. The results suggest a mechanistic asymmetry between reduplication and reversal. Reduplication shows evidence of implicit learning, with different PWM components limiting performance at different base lengths: form encoding/matching at 3σ-Red (Trial × NWR: β = 0.28 [0.12, 0.45], *pd* = 1.00; no credible digit-span effect); maximum digit span at 5σ-Red (Trial×DigitSpan: β = 0.29 [0.08, 0.50], *pd* > 0.99; no credible NWR effect); the same task and population recruit different PWM measures as base length varies (Fig. 1). In reversal, NWR showed a small positive baseline effect (β = 0.06-0.09, *pd* > 0.95) but no credible Trial×PWM interactions, indicating PWM supports stimulus encoding but does not drive implicit learning of the pattern. A post-task survey probed verbalizable rules: in reduplication, both staters and non-staters showed learning (Trial×Stater: β = 0.64-0.76, *pd* = 1.00); in reversal, learning was confined to staters (Trial×Stater: β = 0.24-0.57, *pd* > 0.99), with non-stater slopes near zero (Fig. 2). The asymmetry suggests a learnability divide between patterns learnable through implicit PWM-mediated learning and patterns that appear to require explicit rule discovery [4].

References. [1] Baddeley, A. D. (1986). *Working Memory*. Oxford: Clarendon Press. [2] Wang, Y., & Hunter, T. (2023). On regular copying languages. *Journal of Language Modelling*, 11(1), 1–66. [3] Moreton, E., Prickett, B., Pertsova, K., Fennell, J., Pater, J., & Sanders, L. (2021). Learning repetition, but not syllable reversal. In R. Bennett et al. (eds.), *Supplemental Proceedings of AMP 2020*. [4] Moreton, E., & Pertsova, K. (2024). Implicit and explicit processes in phonological concept learning. *Phonology*, 40(2), 1–53.

Figures and Tables

	Red	**Rev**
3σ base (7σ total)	N = 100 (0 excluded) ***Target:*** fuˈsɑ.zoʊ.bæ.fuˈsɑ.zoʊ ***Foil:*** toʊˈgu.bi.dɑ.guˈbi.toʊ	N = 100 (2 excluded → 98) ***Target:*** fuˈsɑ.zoʊ.bæ.zoʊˈsɑ.fu ***Foil:*** toʊˈgu.bi.dɑ.guˈtoʊ.bi
5σ base (11σ total)	N = 101 (1 excluded → 100) ***Target:*** su.fʊˈgi.pɪ.keɪ.dɑ.su.fʊˈgi.pɪ.keɪ ***Foil:*** tɑ.piˈkɛ.ʃæ.gu.bɪ.kɛ.tɑˈgu.ʃæ.pi	N = 100 (1 excluded → 99) ***Target:*** su.fʊˈgi.pɪ.keɪ.dɑ.keɪ.pɪ.ˈgi.fʊ.su ***Foil:*** tɑ.piˈkɛ.ʃæ.gu.bɪ.kɛ.tɑˈgu.ʃæ.pi

Table 1. Between-subject 2 × 2 design.

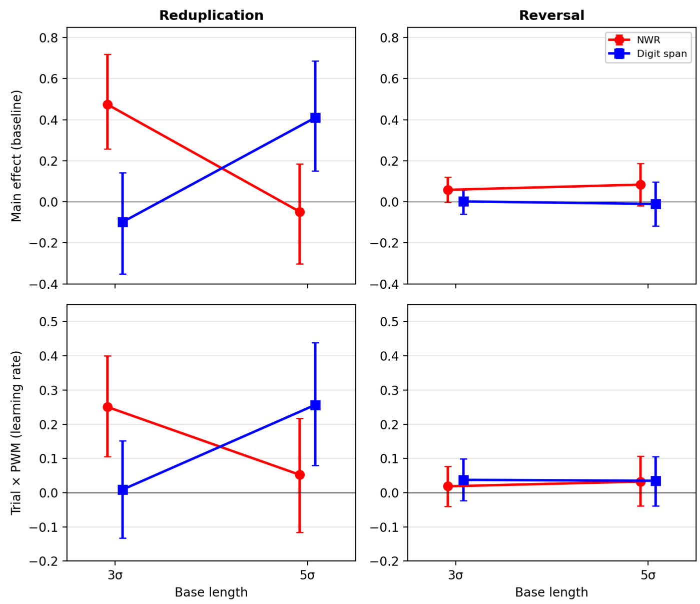

Figure 1.
The parameter estimates of PWM effects: Baseline accuracy (top; main effect) and learning rate (bottom; interaction terms) across base lengths. Red: NWR; Blue: max digit span. In reduplication (left), NWR predicts learning at 3σ whereas digit span predicts learning at 5σ; reversal (right) shows no corresponding PWM modulation of learning rate though NWR is associated with a small baseline accuracy boost.

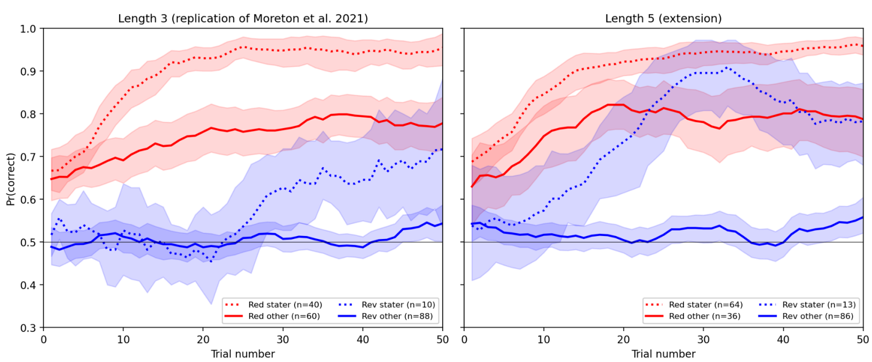

Figure 2.
Reduplication shows learning overall whereas reversal learning is only among rule-staters. Curves are moving averages (radius 5); bands are 95% bootstrap CIs.