

Daily Cognitive Function in Dementia Assessed Using Smartphone-Based EMA: Links with Dyadic Sleep

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BACKGROUND

- Poor cognitive function in persons living with dementia (PLWD) is significantly associated with their sleep problems and can further disrupt the sleep of their family caregivers
- Less is known about how nightly sleep variability relates to next-day cognitive performance in PLWD
- Smartphone-based cognitive ecological momentary assessment (EMA) enables repeated, real-world assessment and may be uniquely suited to capture sleep-cognition fluctuations

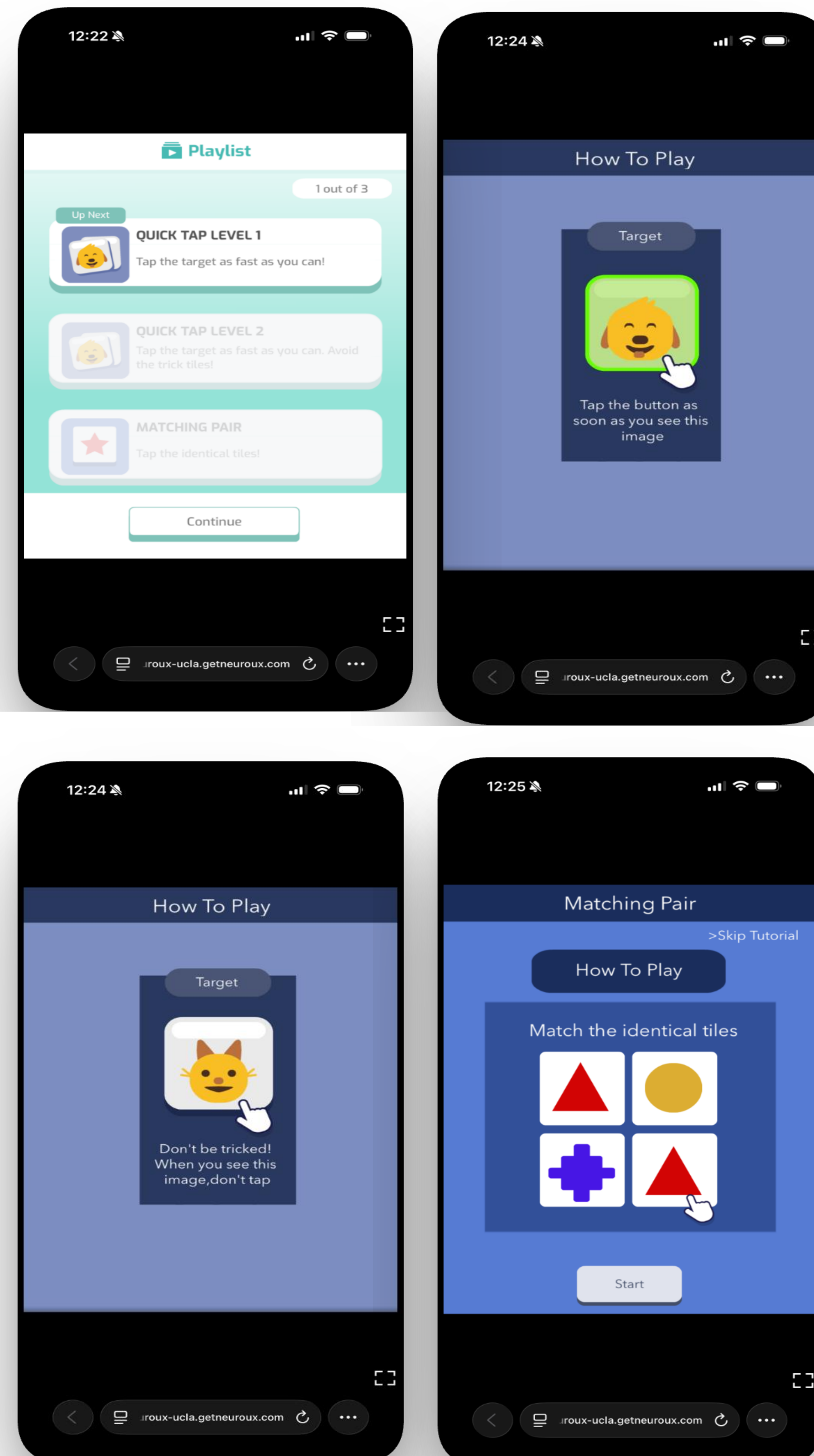
OBJECTIVES

- To examine associations between EMA-based cognitive performance in PLWD and sleep outcomes in dyads

METHODS

- A secondary analysis of baseline data from an ongoing clinical trial
- 75 caregivers completed daily diary and 75 PLWD completed cognitive EMA tasks via caregivers' smartphones 3 times/day for 7 days via NeuroUX
- PWLD cognitive measures: (1) Quick Tap 1 (QT1; psychomotor speed), (2) Quick Tap 2 (QT2; response inhibition), and (3) Matching Pair (MP; processing speed). Aggregated scores (mean, median, maximum, and variability) were computed across sessions (morning, midday, and evening) and day. MMSE was also administered.
- Dyad sleep measures: (1) good sleep: % of nights without difficulty falling asleep or staying asleep (range from 0 to 100%) and (2) time in bed (TIB): difference between bedtime and get-up time
- Covariates: PLWD age, gender, education, and phone type (iOS/Android)
- Data analysis: Pearson correlations (using aggregated data), and mixed-effect regression for repeated measures (using non-aggregated data)

Figure 1. Screenshots of NeuroUX mobile based cognitive EMA testing



RESULTS

- **Bivariate Cognitive Measures & Sleep (PLWD and Caregiver):**
 - Shorter PLWD TIB linked to higher QT1 ($r=-0.22$, $p=0.054$), QT2 max ($r=-0.30$, $p=0.012$), and MMSE ($r=-0.37$, $p=0.002$); MMSE link held after adjustment ($r=-0.37$, $p=0.005$)
 - Greater MP variability linked to more PLWD good-sleep nights after adjustment ($r=0.28$, $p=0.030$)
 - Higher QT2 scores linked to more caregiver good-sleep nights ($r=0.26-0.35$) and shorter caregiver TIB ($r=-0.25$ to -0.34); QT2 max held after adjustment (good sleep: $r=0.27$, $p=0.032$; TIB: $r=-0.33$, $p=0.009$)
 - Higher MP scores linked to shorter caregiver TIB ($r=-0.25$); QT1 also linked to shorter caregiver TIB after adjustment ($r=-0.25$, $p=0.048$)
- **Mixed-Effects Models:**
 - **Session effect on QT1:** QT1 scores were higher in the morning ($b=0.78$) and midday ($b=0.67$) than evening (both $p<0.001$)
 - **PLWD sleep $\times$ session:** The link between PLWD sleep quality and QT1 performance was significantly weaker in the morning than evening ($b=-0.53$, $p=0.049$); midday did not differ from evening
 - **Caregiver TIB $\times$ session:** The link between caregiver TIB and PLWD MP performance was significantly stronger in the morning than evening ($b=4.00$, $p=0.006$); midday did not differ from evening
 - No significant sleep $\times$ session interactions were found

CONCLUSIONS

- Smartphone-based cognitive EMA detected meaningful, time-varying associations between sleep and cognitive performance in PLWD-caregiver dyads that were not captured by traditional measures
- This highlights the importance of considering both assessment timing and dyadic context when examining sleep-cognition relationships in PLWD



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