

# Health and Self Esteem

**Mental Alertness and Heart Rate via Smartwatch Predict Everyday Cognition: Multilevel and Person-Specific Analyses** E. French, C. Luna, S. Dai, D. Cook, B. Minor, & M. Schmitter-Edgecombe. *Gerontechnology* 25(s)

**Purpose** Prior research demonstrates that both self-reported mental alertness, assessed via ecological momentary assessments (EMA), and objective biometric indicators (heart rate and short-term heart rate fluctuation) influence everyday cognition [1]. However, few studies have examined whether the effects of subjective and objective measures are independent or examined how they vary at the within-subject level. This study used smartwatch-based assessments to examine (1) whether EMA-measured self-reported mental alertness and smartwatch-derived heart rate metrics independently predict cognitive performance in everyday environments, and (2) whether these predictors show consistent patterns at the person-specific levels. **Method** *Data and Participants.* Participants were community-dwelling older adults with memory concerns (age 50+; 70% female; 92% White) enrolled in a larger study. Exclusion criteria included psychiatric or medical conditions and significant hearing or vision challenges. Data was collected four times daily for one week period via smartwatches. Subjects with less than 12 valid prompts and residuals outside  $\pm 3$  SD using inverse curve fitting were treated as outliers and removed from analysis. The final sample consisted of 828 repeated observations from 33 subjects. *Variables.* At each prompt, participants rated mental alertness (“right now, I feel mentally sharp and alert”) on a 1 (not at all) to 7 (extremely) Likert scale. Cognition was measured using a 45-second executive attention task (the *n*-back shape test). Heart rate metrics were participants’ average heart rate and standard deviation within three minutes of each prompt. Age, sex, and education served as covariates. *Analysis.* Longitudinal multilevel modeling (MLM) was used to address Aim#1, with repeated observations nested within subjects. An AR1 covariance structure was used to account for autocorrelation in longitudinal data. Predictors were person-mean centered to separate within- and between-subject effects. To address Aim#2, person-specific regressions and correlations were used to explore within-subject heterogeneity. All analyses were achieved using R. **Results and Discussion** *Aim#1.* When modeled separately, all three predictors, including mental alertness ( $\beta = 0.51, p < .001$ ), heart rate ( $\beta = 0.05, p < .001$ ), and short-term heart rate fluctuation ( $\beta = 0.10, p = .04$ ), were significant predictors of cognition in everyday environments. When combined, the magnitude and significance of mental alertness ( $\beta = 0.47, p < .001$ ) and heart rate ( $\beta = 0.04, p < .001$ ) were similar. The inclusion of both mental alertness ( $\beta = 0.50, p < .001$ ) and short-term heart rate fluctuation ( $\beta = 0.08, p = .09$ ) in the same model turned the significance of short-term heart rate fluctuation from marginal to insignificant. The magnitudes of coefficients, however, were similar. *Aim#2.* MLM Intraclass correlations indicated ~77% of cognition variance between subjects. Person-specific analyses revealed heterogeneity across participants in direction, significance, and effect sizes. The patterns of heterogeneity varied across the three predictors, with some participants showing strong positive links for both predictors, others mixed or none. *Discussion.* These findings suggest that subjective alertness and biometric indicators exert independent influences on everyday cognition. These results highlight the potential of wearable technologies that integrate physiological data with EMA self-report and cognitive testing for personalized monitoring and in-the-moment intervention.

## References

1. Nicolini, P., Malfatto, G., & Lucchi, A. (2024). Heart rate variability and cognition: A narrative systematic review of longitudinal studies. *Journal of Clinical Medicine*, 13(1), 280.

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